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Findings & Recommendations

On

The Development of a Statewide Enhanced 9-1-1 Voice and Data Delivery Network

submitted to:

The Montana Public Safety Services Office

April 2004

L. Robert Kimball & Associates
Architects and Engineers

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1. EXECUTIVE SUMMARY

1.1 OVERVIEW

The Montana Public Safety Services Office ("PSSO") has undertaken an effort to explore alternatives and solutions for the delivery and processing of 9-1-1 calls (both wireline and wireless) across the state. The PSSO is interested in investigating the viability and feasibility of establishing a consistent, standardized and more efficient 9-1-1 system in Montana which will improve public safety for all citizens.

The strategic plan of the PSSO states that:

> *"This office is responsible for managing the state's 9-1-1 program on behalf of all 9-1-1 jurisdictions. It provides a single point of coordination and support associated with state responsibilities for managing the 9-1-1 Program. The office manages the department's statutory responsibilities for the development, implementation, and operation of 9-1-1 emergency telephone systems throughout the state. This office works closely with managers of 9-1-1 jurisdictions, emergency response providers, elected officials and telephone company personnel in the planning, implementation, and funding of emergency telephone systems."*

The PSSO envisions a system that will:

- Improve public safety for all citizens
- Elevate 9-1-1 services to the same consistent level statewide
- Provide a quality service to the public
- Provide for the efficient and effective use of federal appropriations and surcharge funds
- Be redundant, diverse, and immune or tolerant to failure or disaster
- Provide for emergency notification services (a.k.a. reverse 9-1-1)
- Provide Public Safety Answering Points ("PSAPs") with the ability to process both wireless and wireline Enhanced 9-1-1 calls to all citizens in all areas
- Allow for economies of scale with respect to costs, equipment, technology, and service.
- Provide a foundation for future public safety technologies
- Establish Montana as a model in public safety services and the implementation and deployment of public safety technologies

1.2 BACKGROUND

In December of 2003, the PSSO commissioned L. Robert Kimball & Associates ("Kimball") to undertake this study in order to focus direction and provide technical recommendations on the considerations required of and potential implementation strategies for a statewide 9-1-1 system.

The PSSO charged Kimball to perform the following:

- Provide a baseline assessment of previously collected PSAP survey data
- Provide analysis, conclusions, and recommendations based on the assessment
- Obtain and convey an understanding of 9-1-1 in Montana
- Understand and articulate the goals and requirements of the PSSO for improving all forms of 9-1-1 call processing
- Explore alternative solutions available to the PSSO with respect to improving all forms of 9-1-1 call processing in Montana
- Confirm or rule out the possibility of a statewide system in Montana based on the expertise and experience Kimball has developed with similar projects
- Provide "Next Step" recommendations and strategies for moving the goals and requirements of the PSSO forward to improve public safety for the citizens of Montana

1.3 FINDINGS AND RECOMMENDATIONS

After extensive review and analysis of current conditions in Montana, and having developed an in depth understanding of 9-1-1 in Montana, Kimball stipulates as findings of fact or recommends the following:

Kimball stipulates that the PSSO through past and current activities is principally interested in improving public safety for all citizens and promoting the most efficient use of 9-1-1 federal appropriations and surcharge funds.

Kimball stipulates that the PSSO is fulfilling and promoting the goals of its strategic plan through this exploration and investigation of a statewide 9-1-1 system.

Kimball stipulates that a statewide approach to providing enhanced 9-1-1 services is the only economical, efficient, and timely way to establish consistent, quality public safety services to all citizens of Montana. The piecemeal approach in practice today is similar in concept to a marathon race; some PSAPs will make it across the finish line, some PSAPs won't, which in turn means that some citizens will be safer, some won't.

Kimball stipulates that the PSSO is in a unique position and at a critical moment in time to move public safety in Montana forward by leaps and bounds in terms of services, quality, economies of scale, purchasing power, and technology as they relate to all forms of 9-1-1. This can only be achieved now, and can only be accomplished by the oversight of a statewide entity like the PSSO.

Kimball recommends that the PSSO develop a Request for Proposals ("RFP") document to solicit solutions for a statewide 9-1-1 system. Kimball further recommends that the RFP should encourage potential respondents to propose a total "turn key" solution that would meet or exceed the goals and requirements established by the PSSO and listed above.

Kimball recommends that a regional 9-1-1 model which establishes regional selective routing and ANI/ALI controlling would serve as the best model for implementing enhanced 9-1-1 services across Montana by reducing overall networking costs and providing flexibility in equipping individual PSAPs with ANI/ALI controlling functions at potentially lower costs.

Kimball recommends that the current statewide ATM network or any existing network be considered as a piece of the network transport solution for any future proposed system designed to provide enhanced 9-1-1 services. The utilization of existing networks may reduce costs. Any costs associated with using existing networks would be incremental as opposed to the total cost of building and provisioning a new network.

Kimball stipulates that as each municipality develops its own 9-1-1 plans, moves forward independently and implements enhanced 9-1-1 services, that the resulting patch work of solutions, different makes of equipment, and unique or custom installations would not provide for the efficient use of grant and surcharge funds and will not support the charter and long term goals of the PSSO or the future requirements and technical direction of the public safety industry.

Kimball stipulates that the PSSO through dedication, perseverance and creativity has been awarded federal appropriations to use in the establishment of a statewide 9-1-1 system. The PSSO has a responsibility to the citizens of Montana and now the country to utilize these funds in the most efficient and cost effective manner possible. A statewide 9-1-1 system based on a regional model holds the most potential for successfully fulfilling this responsibility.

Kimball stipulates and concludes after analyzing all of the PSAP survey data that the majority of Montana's present PSAP equipment has aged beyond reliability or may no longer be economical to upgrade to provide enhanced 9-1-1 services.

Kimball stipulates that most of the PSAPs in Montana are in the process of moving forward, independently, towards providing enhanced 9-1-1 services to their jurisdictions. Capitol budgets are being established and funds may already be encumbered to purchase, install and deploy enhanced 9-1-1 services. A united effort, not one done independently, will provide economies of scale and cost savings *vis a vis* purchasing power that is not available to individual PSAPs.

Kimball stipulates that the impacts to PSAPs from the potential implementation of a statewide system would not be any more or less than would occur from the normal progression from basic 9-1-1 services to enhanced 9-1-1 services. Kimball further stipulates that the implementation of a statewide system could potentially minimize the impact to individual PSAPs if the PSSO were to provide coordination, project management and standardized training.

Kimball recommends that public safety technology of the future needs to be considered and planned for now. Kimball recommends that any RFP developed from these recommendations include provisions or specifications to accommodate Voice Over Internet Protocol (VoIP) and Telematics or Automatic Crash Notification technologies that require interfaces to public safety 9-1-1 networks.

2. BASELINE ASSESSMENT OF CURRENT 9-1-1 ENVIRONMENT

2.1 CURRENT CONDITIONS/ENVIRONMENT

During the fall of 2003, the PSSO conducted a PSAP survey to develop an inventory of equipment and capabilities of each PSAP providing 9-1-1 services to the public. This information has been provided to Kimball, and will serve as the basis for the analysis, information and conclusions presented in this section.

There are approximately 550,000 wireline or access lines in the state, with an additional 300,000 wireless accounts. Each access line and wireless account contributes $.50 in surcharge fees to the 9-1-1 system. This number will fluctuate based on time of year, and the transition from wireline/access lines to wireless accounts. The current trend nationwide is showing that the access line counts are declining while the wireless subscriber counts are increasing.

There are 18 Independent Local Exchange Carriers ("ILECs") and 1 Local Exchange Carrier ("LECs") or telephone companies which provide telephone service at various locations across the state. LECs/ILECs traditionally also provide 9-1-1 service to PSAPs and are integral to 9-1-1 systems today. The current telephone companies are:

Blackfoot Telephone Cooperative	Northern Telephone Cooperative
Central Montana Communications	Project Telephone Company
Century Communications	Range Telephone Cooperative
Citizen Communications	Ronan Telephone Company
Clark Fork Telecommunications	Southern Montana Telephone Company
Hot Springs Telephone Company	3 – Rivers Telephone Cooperative
InterBel Telephone Company	Triangle Telephone Cooperative
Lincoln Telephone Company	Qwest Communications
Mid-Rivers Telephone Cooperative	Valley Telecommunications
Nemont Telephone Cooperative	

There are 8 wireless carriers providing wireless service in Montana they are:

3 Rivers	Mid-Rivers Cellular
AirTel Montana	Qwest
Blackfoot Communications	Sagebrush Cellular
Cellular One/Western Wireless	Verizon Wireless

There are two (2) forms of 9-1-1, basic and enhanced.

Basic 9-1-1 is defined as the routing of an emergency call via the digits 9-1-1 to a PSAP established to serve the geographic area (town, county) where the call was made. Basic 9-1-1 provides the telephone number or Automatic Number Identifier ("ANI") of the caller to the PSAP.

Enhanced 9-1-1 is defined as the selective routing of a 9-1-1 call to the PSAP which serves the area where the call was made. Enhanced 9-1-1 provides the ANI as well as the 9-1-1 address or Automatic Location Identifier ("ALI") where the call is being made from.

In addition to basic and enhanced 9-1-1, there are separate distinctions made when considering 9-1-1 calls made from wireless telephones. The Federal Communications Commission ("FCC") has mandated in report and order 94-102 that wireless 9-1-1 calls must receive the same level of service as landline or wireline 9-1-1 calls. The FCC established two (2) phases of wireless 9-1-1 capability known as Phase I and Phase II.

Phase I Wireless 9-1-1 is defined as the routing of a wireless 9-1-1 call to a PSAP in the general geographic area of the caller, that the call back number is provided (ANI) and that the location information (ALI) of the tower which received the call is provided to the PSAP.

Phase II Wireless E9-1-1 is defined as the routing of a wireless 9-1-1 call to the PSAP serving the geographic area the call is being made from, the call back number (ANI) as well as the location information including latitude and longitude (X,Y) of the person making the call.

Both phases of wireless 9-1-1 require the ability to process and display location or ALI information at the PSAP receiving the call.

2.2 PSAP ANALYSIS

Kimball's analysis of the collected survey information has provided a good deal of insight into the 9-1-1 environment of Montana. This section will provide a summary of this analysis.

There are 58 PSAPs operating in the state. The previously discussed survey and data collection effort covered 57 PSAPs (the Blackfeet PSAP was not included). According to the survey data, the breakdown of PSAPs which provide either enhanced or basic 9-1-1 services is:

Type of Service	# of PSAPs
Basic 9-1-1 service	42
Enhanced 9-1-1 service	16
Wireless Phase I service	1 of 16

These numbers are significant in that it points out the fact that Montana is in a very unique position. Montana and the PSSO have the opportunity to take a large, almost quantum, leap forward in public safety services to all citizens due to the fact that most of the PSAPs in the state provide only basic 9-1-1 services (42). To achieve the stated goal of providing enhanced 9-1-1 capabilities to all PSAPs, these 42 would need to be upgraded, and the citizens served by these PSAPs would benefit from a higher level of public safety.

If a PSAP today wishes to migrate from basic 9-1-1 to enhanced 9-1-1, the PSAP must file a plan with the PSSO. These 42 PSAPs, which offer basic 9-1-1 today, would need to file individual plans, coordinate with vendors, negotiate contracts, incur costs, and manage the installation and implementation of each system. Today, this occurs independently on an individual PSAP by PSAP basis.

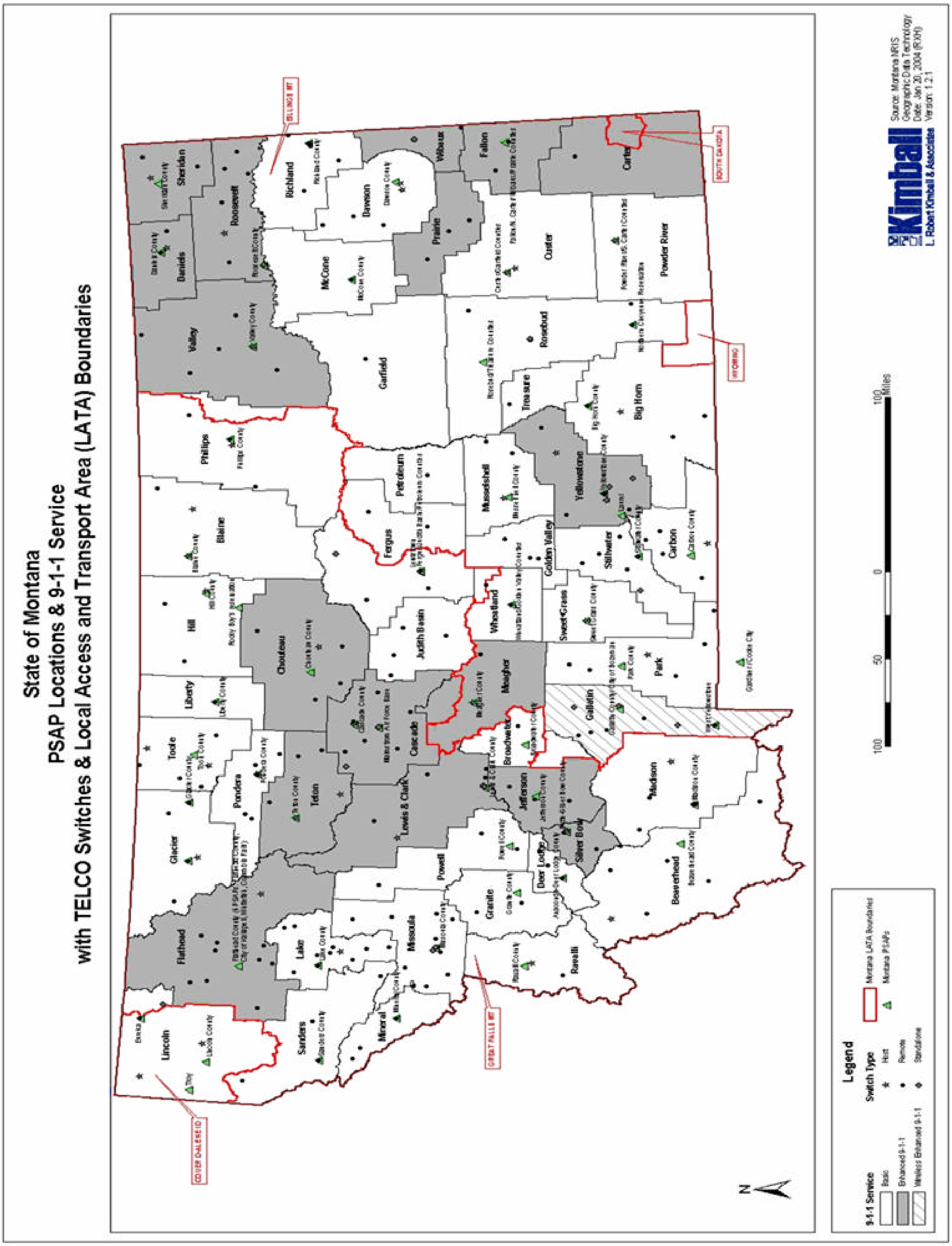
Of the 42 PSAPs providing basic 9-1-1 today, 33 have approved plans, 2 are pending approval and 7 PSAPs have taken no action to file a plan. The PSSO estimates that the capitol costs required to equip, install, deploy, and implement the 35 plans approved or pending will average out to be $250,000 per PSAP.

That translates into an estimated $8,750,000 in capitol costs and surcharge monies that must be incurred in order to enable these 35 PSAPs to provide enhanced 9-1-1 services.

These plans, by their very nature, do nothing to address the delivery network which will provide calls and data to the PSAP. They are primarily focused on the equipment, addressing and coordination necessary to enable the PSAP to handle enhanced 9-1-1 calls.

Kimball believes based on experiences elsewhere, that the PSSO through a statewide system effort and procurement will be able to achieve the same level of services for these 35 PSAPs for less that the estimated cost ($8.75 million) of the PSAPs doing so independently.

A map displaying PSAP locations, telephone switching centers, as well as depicting which areas are provided basic or enhanced 9-1-1 service is shown on the next page.


State of Montana
PSAP Locations & 9-1-1 Service
with TELCO Switches & Local Access and Transport Area (LATA) Boundaries
BILLINGS MT
SOUTH DAKOTA
WYOMING
GREAT FALLS MT
COEUR D'ALENE ID
Lincoln
Flathead
Glacier
Toole
Liberty
Hill
Blaine
Phillips
Valley
Daniels
Sheridan
Roosevelt
Richland
McCone
Dawson
Wibaux
Prairie
Fallon
Carter
Custer
Powder River
Rosebud
Garfield
Treasure
Big Horn
Yellowstone
Musselshell
Petroleum
Fergus
Judith Basin
Wheatland
Golden Valley
Stillwater
Carbon
Sweet Grass
Park
Gallatin
Meagher
Broadwater
Cascade
Chouteau
Pondera
Teton
Lewis & Clark
Jefferson
Madison
Silver Bow
Deer Lodge
Beaverhead
Powell
Granite
Ravalli
Missoula
Mineral
Sanders
Lake
Legend
Switch Type
Host
Remote
Standalone
Montana LATA Boundaries
Montana PSAPs
9-1-1 Service
Basic
Enhanced 9-1-1
Wireless Enhanced 9-1-1
0
50
100
Miles
Kimball
L. Robert Kimball & Associates

We can also reach an understanding of PSAP capability or potential capability by looking at the number of positions which answer 9-1-1 calls in each PSAP. The number of positions in a PSAP can often provide anecdotal evidence as to how busy a PSAP is or might be.

# of Positions	Basic	Enhanced	Total
1 position PSAPs	19	2	21
2 position PSAPs	17	8	25
3 position PSAPs	3	1	4
4 position PSAPs	1	3	4
5 position PSAPs	0	0	0
6 position PSAPs	1	0	1
7 position PSAPs	0	2	2
8 position PSAPs	0	0	0

Table 1 PSAPs by Position

Using this information, we can conclude that 46 out of 58 PSAPs answer 9-1-1 calls with 1 or 2 positions, and there are no PSAPs which have more than 7 positions.

1 or 2 position PSAPs tend to serve areas that do not have large concentrations of population or telephone lines. Given that there are few population concentrations in Montana, it stands to reason that 9-1-1 today is provided mostly by 1 or 2 position PSAPs.

Population drives the demand for public safety services. Given that the majority of PSAPs in Montana are 1 or 2 positions, then the demand for improved public safety services may never be achieved if left to evolve as it has to the present day.

The fact that 7 PSAPs have not filed plans to progress to enhanced 9-1-1 call processing backs up the notion that not all citizens will receive the same consistent level of public safety services as they would if a statewide system were implemented.

2.3 PSAPS REQUIRING UPGRADE

In order for a PSAP to process wireless Phase I and II 9-1-1 calls, the PSAP equipment must be able to process, at a minimum, ALI data and information. As stated earlier, this is and has been a function of enhanced 9-1-1.

Due to the mix of service levels that exist today in PSAPs in Montana and in order for the PSSO to meet its stated goals and objectives for a statewide 9-1-1 network, Kimball anticipates that a majority of PSAPs in the state will require equipment upgrades in order to process all 9-1-1 calls (both wireless and wireline) in a consistent and standardized manner.

Based on Kimball's analysis of the survey data, the potential for PSAP equipment upgrades breaks down as follows:

May not be economical to upgrade – equipment may be upgradeable, but the cost to do so may be higher than simply replacing. This could be due to age of the equipment, lack of vendor support, etc.

Upgrade solution needs to be investigated – based on the information provided in the survey, Kimball is unable to determine if the specific equipment needs to be replaced or not.

Systems are upgradeable or capable – based on information provided in the survey, Kimball has determined that the equipment inventoried is able to provide enhanced 9-1-1 functions, and or is easily modified to do so.

Enhanced PSAPs

Upgrade Category	# of PSAPs
May not be economical to upgrade	4
Upgrade solution needs to be investigated	5
Systems are upgradeable or capable	7

Basic PSAPs

Upgrade Category	# of PSAPs
No ANI / ALI controller – requires upgrade	28
May not be economical to upgrade	3
Upgrade solution needs to be investigated	9
Systems are upgradeable or capable	0

As a general rule, all of the PSAPs that provide basic 9-1-1 capability today would require an equipment upgrade in order to process enhanced 9-1-1 and wireless Phase I and II 9-1-1 calls.

2.4 CONCLUSIONS

Kimball's analysis of the survey has led us to the following conclusions:

28 PSAPs will need to have new ANI/ALI controllers installed or provisioned in order to provide enhanced 9-1-1 services. There is a cost associated with that. The cost could be borne by the individual PSAP or by the combined purchasing power of all PSAPs at an anticipated savings if procured along with a statewide system.

42 PSAPs will need to replace call taking equipment currently in place. 35 have filed plans to do so at a potential PSSO estimated cost of $5,000,000. This again may be less if combined with a total statewide effort to procure and implement enhanced 9-1-1 services.

The capitol costs associated with these replacements will be high and would depend on specific capabilities and functions, but these costs would be incurred by any PSAP already planning to

provide enhanced 9-1-1. The PSSO through this investigation and any future implementation is not going to burden PSAPs with costs that are not already being planned for.

In general, the PSAP environment in Montana is reflective of the population level and the evolutionary nature of 9-1-1 as it has progressed over the years. As population centers grow, so too does the demand for public safety services like 9-1-1. It is safe to assume that the current and existing concentrations of population in the state are being served by PSAPs that have more than 2 answering positions and already provide enhanced 9-1-1 services.

When using the number of positions in a PSAP as a basis for analysis, the notion that 9-1-1 follows population and demand for services is reinforced. Most of the PSAPs in Montana (46 out of 58) contain 1 or 2 answering positions which supports the notion that most of Montana is not highly populated.

In addition to equipment upgrades or changes, there will be an operational impact on all PSAPs. 42 of the 58 PSAPs do not process enhanced 9-1-1 calls today and only 1 of the 58 processes wireless 9-1-1 calls. The implementation of any new system which will enable all PSAPs to process all types of 9-1-1 calls will require extensive training and standards development at the PSAP level.

That is not to say that this investigation by the PSSO would be responsible for this operational impact. This impact would occur anyway as the transition takes place from providing basic 9-1-1 services to enhanced 9-1-1 services.

3. ITEMS FOR CONSIDERATION

3.1 BASELINE GOALS/REQUIREMENTS OF THE PSSO

The PSSO would like to establish a system that will provide consistent and standardized 9-1-1 services across Montana. The overarching goal is to have 1 system to process, route and deliver all forms of 9-1-1 calls to PSAPs which are able to process all types of 9-1-1 calls, as well as enable all PSAPs to notify residents served of potential emergencies or pending events.

As stated earlier, the goals of the PSSO for an overall 9-1-1 system are to:

- Improve public safety for all citizens
- Elevate 9-1-1 services to the same consistent level statewide
- Provide a quality service to the public
- Provide for the efficient and effective use of federal appropriations and surcharge funds
- Be redundant, diverse and immune or tolerant to failure or disaster
- Provide for emergency notification services (a.k.a. reverse 9-1-1)
- Provide Public Safety Answering Points ("PSAPs") with the ability to process both wireless and wireline Enhanced 9-1-1 calls to all citizens in all areas
- Allow for economies of scale with respect to costs, equipment, technology and service.
- Provide a foundation for future public safety technologies
- Establish Montana as a model in public safety services and the implementation and deployment of public safety technologies

Clear, concise project goals are necessary for eventual success and will serve as the map all stakeholders will follow as the finer details of this system are worked out and progress is made toward a potential implementation.

This remainder of this section will highlight areas of consideration for the PSSO to further refine stated goals and objectives and which may need to be explored in detail as this effort progresses.

The additional areas for consideration are:

- Costs
- Current State Network
- Wireless Carriers
- Wireless 9-1-1
- Emerging Technologies

3.2 COSTS

A critical component to any undertaking of this magnitude is cost. The cost of establishing a homogeneous 9-1-1 system across the state the size of Montana can be quite prohibitive and often serves as a barrier or obstacle to implementation.

The PSSO is fortunate enough to have received federal appropriations for this initiative and as such, should be able to overcome the "sticker shock" affect that initial costs for a system of this size and scope usually entail.

While costs for a system like this may be high, many of the costs associated with providing enhanced 9-1-1 services are being planned and budgeted for by a majority of PSAPs today. The overall costs for a system like this when approached on a statewide basis coupled with the combined purchasing power of the PSAPs will be lower in the end.

Costs can be broken down into 2 broad categories:

3.2.1.1 One-time Costs

One-time costs are those costs paid for material and services necessary for the operational implementation of the proposed solution.

3.2.1.2 Continuing/Recurring Costs

Continuing costs are those costs that are projected to be paid on a monthly basis.

With the federal appropriations, the one-time initial costs should be covered. It is the monthly recurring costs which could outstrip incoming revenue and therefore make the system unfeasible on an on going continuous basis.

Cost factors, or those areas that will contribute to the overall system costs are included in one of the following categories:

- Network
- Equipment – hardware/software
- Facilities
- Maintenance
- Monitoring
- Staffing
- ALI Database and Addressing
- Training

We will now explore each of these cost contributors in detail and provide additional insight into the factors that may affect these costs.

3.2.1.3 Network Costs

Kimball anticipates that charges required to establish connectivity to and from any statewide 9-1-1 network will be extensive.

Network costs for both voice and data connectivity will be required for any statewide implementation.

Variables that can impact the cost of a network include:

- Circuit mileage or the physical length of a circuit
- Required bandwidth capacity of the circuit
- The technology used to communicate across the circuit
- The number of circuits required for redundancy and diversity to ensure proper and continuous operation
- Location of network connection points
- Availability of existing infrastructure

In addition, there are common practices that the PSSO can pursue which may reduce or mitigate the impact some of the variables listed above have on costs, these are:

- Network aggregation or concentration – smaller connections aggregate into one larger connection
- Utilization of existing networks – costs become incremental
- Updating or upgrading equipment used on existing networks – add capacity by changing equipment not buying more circuits

3.2.1.4 Hardware/Software Costs

Costs for both hardware and software required to operate the entire system as well as individual system components will contribute to overall costs and need to be considered. An entire 9-1-1 call processing system as envisioned will consist of:

- Selective Routing hardware and software
- ALI database hardware and software
- Emergency notification hardware and software
- 9-1-1 call taking hardware and software
- 9-1-1 call taking MIS hardware and software
- Mapping display hardware and software for wireless 9-1-1
- 9-1-1 call recording hardware and software

While these costs are being discussed in terms of overall system cost, as stated in Section 2, four of the costs listed above are going to be incurred by PSAPs transitioning to enhanced 9-1-1 services with or without a statewide network.

3.2.2 Facilities

Facilities to house the equipment that will operate the 9-1-1 system will come at a cost as well. In general, these facilities require extensive security, monitoring and mitigation of potential man made and natural disasters.

The PSSO may be required to retro fit existing facilities to support these requirements, or be prepared to pay for these requirements as part of a proposed solution.

The list of factors which will affect facility costs are:

- Ownership vs. lease
- Bonding and grounding
- Lightning mitigation
- Facility design and construction
- Level of protection from natural disasters
- Level of mitigation from man made disaster
- Diverse entries for commercial power, network circuits
- Unlimited power supply capability
- Capability to operate from generator power
- Geographic location
- Security systems
- Alarm systems
- Monitoring systems

The PSSO can anticipate that structures will have to be modified to attain the required level of protection and security for the continuous operation of a statewide system.

3.2.3 Maintenance

If this critical system is designed and put into operation, the process of keeping it up and running becomes critical as well. The cost of maintaining a statewide system could have a high recurring cost.

There are several factors which can impact the cost of maintenance, they are:

- Required response times to respond to outages – short/quick response may require more technicians
- Amount of equipment – more equipment, may mean more technicians to support the operation of the equipment
- Location of equipment – more locations may make it harder to support and may require more technicians to support the continuous operation of the system
- Level of spare parts required to keep on hand in the event of component failure
- The make and model of specific equipment, the more diverse, the greater the skill set required to maintain

3.2.4 Monitoring

Monitoring and alarming of critical system components would be necessary and required in order to prevent the loss of the entire 9-1-1 system. The monitoring requirements for a large system with many and varied components can be quite extensive and have cost implications.

Proper monitoring and alarming often require the following functions:

- 24 X 7 monitoring center or function capable of instant system update and status
- Qualified and dedicated staff who can diagnose and troubleshoot alarms generated by the system
- Remote access to critical system components and modules
- Requires equipment capable of being monitored and alarmed

Automation can and will play a role in monitoring. Automation can also minimize some of the costs associated with the monitoring function. Systems today can self diagnose and page, call, or email support staff of problems or issues that the system has self diagnosed. But, the human touch is often still required and has a cost associated with it.

Often, the function of monitoring the system is linked to the maintenance of the system and can be contracted as a whole.

3.2.5 Staffing

We will discuss staffing in terms of:

- Potential staffing costs to the PSSO
- Potential staffing costs to PSAPs

3.2.5.1 PSSO Staffing

Staffing levels for the PSSO may increase and will depend on the level of ownership or oversight the PSSO wishes to undertake if a statewide solution is implemented. Staff additions will be required in the following technical areas if the PSSO chooses to take ownership for operation of the system:

- Network
- Database
- Telephony
- PC systems software and hardware

It may be possible to find the skill sets that match these technical areas in one person, but the reality is it is more likely to be found in two or more people.

If the PSSO decides to function in an oversight role only, then the specific skill sets listed above or a subset are more likely to be found in one person and the others learned while on the job.

3.2.5.2 PSAP Staffing

The implementation of a statewide system for enhanced 9-1-1 services should not require additional staff at the PSAPs.

The transition from basic 9-1-1 services to enhanced 9-1-1 services may place additional strain on the resources of the 1 and 2 position PSAPs, but that requirement would come regardless of a statewide system as the PSAPs naturally progress towards providing enhanced 9-1-1 services.

3.2.6 ALI Database and Addressing

The function of housing, maintaining, updating, and serving Automatic Location Information (ALI) records required for both wireline and wireless 9-1-1 as well as emergency notification services is an additional consideration and potential cost for the PSSO.

This function today is traditionally provided by the LEC, and only occurs for those PSAPs that are capable of enhanced 9-1-1 call processing. There are costs for ALI database functions and they are being paid by PSAPs today.

The PSSO may be able to realize an overall system cost savings if the ALI database function is brought in-house as part of a statewide system. This would require the addition of dedicated staff to maintain the ALI database on a daily basis. That would incur an additional cost which is not being directly paid for today. This is also where the cost savings comes into play, however, all PSAPs today which provide enhanced 9-1-1 services, pay ALI database charges. When totaled across the state, these costs should outweigh any additional cost caused by adding staff to perform this function.

Additionally, as more PSAPs become capable of enhanced 9-1-1 services and more ALI records are added to the ALI database, the staffing requirement may grow.

Municipal addressing is a critical component of ALI databases and in order for an ALI database to be created for a municipality, addressing usually has taken place.

The implementation of a statewide system which enables all PSAPs to process enhanced 9-1-1 calls may require or speed up efforts for municipal addressing. This will come at a cost, but one which would have to be incurred nevertheless as municipalities transition to enhanced 9-1-1 services.

3.2.7 Training

Training costs and the development of a training program would be required in this undertaking. Any system, regardless of specific design, will require extensive retraining and development of process and procedure at the PSAP call taker levels. Especially for those PSAPs that will be making the transition from basic 9-1-1 call taking to enhanced and wireless 9-1-1 call taking.

Training would need to be developed for the following areas:

- Enhanced 9-1-1 call taking
- Wireless Phase I 9-1-1 call taking
- Wireless Phase II 9-1-1 call taking
- Use and operation of new call taking equipment
- Emergency notification services
- Mapping display systems for Phase II

The cost of developing training could be minimized if a portion of the training were developed and administered by the PSSO. Some training, specific to manufacturer or model of equipment will come at a cost, but again would be lower when provided across the board as opposed to a single PSAP by PSAP basis.

3.3 IMPACT ON PSAPS

There are two (2) components to a statewide system, they are:

- The network delivering calls and data to the PSAP
- Call taking equipment capable of answering and processing all types of 9-1-1 calls

If the PSSO moves forward and establishes a statewide enhanced 9-1-1 system, the 9-1-1 call and data delivery network portion of that system should have no impact on PSAPs. This component of a statewide system should be transparent and should merely replace or overlay the current network which delivers 9-1-1 calls to PSAPs today.

The new call taking equipment required to answer and process all forms of 9-1-1 calls will have an impact on PSAPs. The impacts on PSAPs from this new equipment and new level of service will impact PSAPs in the following areas:

- Operations
- Process and Procedure
- Training
- Mapping, GIS, and addressing
- Increased level of support from outside sources
- Staffing

It must be pointed out that PSAPs would be impacted in these areas as they transition to enhanced levels of 9-1-1 call processing regardless of the implementation of a statewide system.

3.4 CURRENT STATE NETWORK

Currently Montana's statewide network is supported via a traditional telephone company leased facility contractual arrangement which supports various nodes of ATM and Frame Relay. Generally stated this network is a DS3 backbone with branches of DS1s or 56K lines terminating at many of the higher education institutions, state, and PSAP facilities.

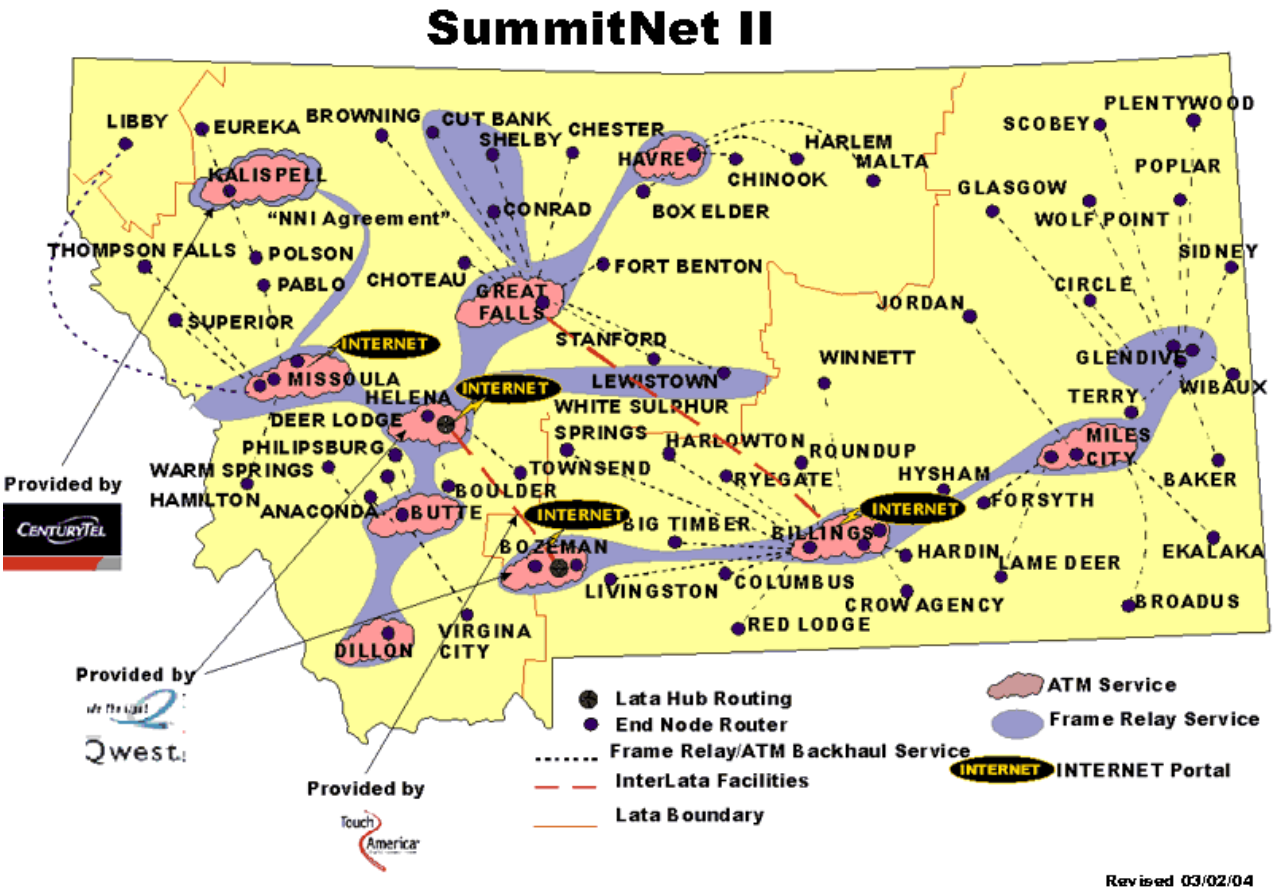
The state is currently migrating a second dedicated "Voice Only" network that is serving the state's PBX infrastructure. The state's Nortel PBX's utilize an ISDN-PRI tie line type arrangement for Intra-state PBX-PBX voice traffic.

Kimball recommends that this network remain a possibility for portion of the transport for 9-1-1 calls. Any equipment that may be proposed as part of a solution via future procurement activity should include the ability to utilize the state network as a minimum requirement.

This recommendation is based on several assumptions:

- Incremental growth to an existing network is much less of an expense than a totally separate E911 Public Safety Network
- The costs of adding access to the state network at many of the node locations are minor compared to the cost of a completely new and dedicated network
- Kimball believes that ALI text files, should be a very minor additional load on the network and could easily be supported over the existing network in many locations. S/R – S/R traffic should also be very low and depending on the S/R location may also be able to be supported over this network
- It is also recognized that the state's network may require additional bandwidth in several areas as well as additional nodes

The elements of and locations served by the state network are depicted on the following page.



3.5 WIRELESS CARRIERS

There are 8 wireless carriers providing wireless service in Montana.

The following table gives summary information on each:

Wireless Carrier	Tier	Technology
3 Rivers	Tier III	Handset based
AirTel Montana	Tier III	TBD
Blackfoot Communication	Tier III	Handset based
Cellular One/Western Wireless	Tier II	Handset based
Mid-Rivers Cellular	Tier III	TBD plan to migrate to Handset based
Qwest	Tier II	Handset based
Sagebrush Cellular	Tier III	Handset based
Verizon Wireless	Tier I	Handset based

The carriers that fall into Tier II are those carriers that had over 500,000 subscribers as of year-end 2001.

Tier II carriers are subject to slightly different deployment schedules as mandated by the FCC for the enabling of wireless Phase I and II 9-1-1.

The schedule for Tier II wireless carriers is:

- Begin selling and activating location-capable handsets no later than **March 1, 2003**
- Ensure that at least 25 percent of all new handsets activated are location capable no later than **May 31, 2003**
- Ensure that at least 50 percent of all new handsets are location-capable no later than **November 30, 2003**
- Ensure that 100 percent of all new digital handsets activated are location capable no later than **May 31, 2004**
- Ensure that penetration of location-capable handsets among its subscribers reaches 95 percent no later than **December 31, 2005**

The schedule for Tier III wireless carriers is:

- Begin selling and activating location-capable handsets no later than **September 1, 2003**
- Ensure that at least 25 percent of all new handsets activated are location capable no later than **November 30, 2003**
- Ensure that at least 50 percent of all new handsets are location-capable no later than **May 31, 2004**
- Ensure that 100 percent of all new digital handsets activated are location capable no later than **November 30, 2004**.
- Ensure that penetration of location-capable handsets among its subscribers reaches 95 percent no later than December 31, 2005.

As the transition from landline telephones to wireless phones continues, the onus of enabling the processing of 9-1-1 calls is going to fall to the wireless carriers. The implementation of statewide 9-1-1 services should assist the wireless carriers in the state to meeting the mandates and timelines of the FCC. A statewide system will facilitate the deployment of wireless 9-1-1 for all carriers in Montana.

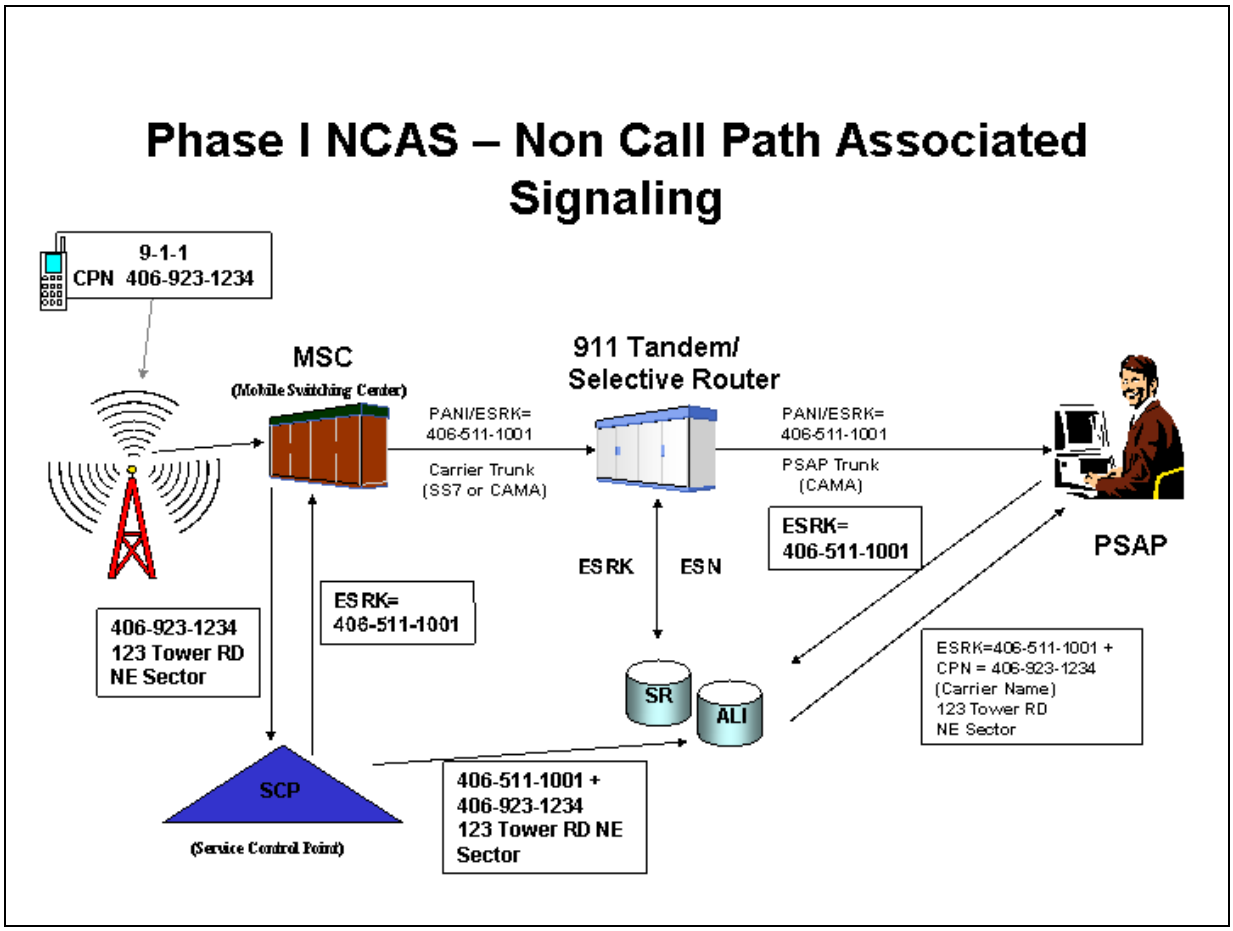
3.5.1 Wireless 9-1-1

Each of the wireless carriers listed above will be providing wireless enhanced 9-1-1 services when requested to do so by individual PSAPs or the PSSO. There are certain FCC mandated requirements that have been placed on all wireless carriers for providing these critical services.

The following sections will describe how wireless 9-1-1 works and how the wireless carriers in Montana will process 9-1-1 calls and interface with current and proposed 9-1-1 systems.

The diagram below illustrates the call flow of a Phase I wireless 9-1-1 call. Recall that during a Phase I wireless 9-1-1 the callers number and the address information of the tower that received the call are passed to the PSAP.

Notice in the diagram that the voice of the caller and the data generated by the call go in different directions, but end up at the PSAP. Also note that the wireless carrier system interfaces with the wireline system that serves as the 9-1-1 network for the PSAP. In other words, wireless 9-1-1 calls today, almost always traverse the current 9-1-1 network in order to reach a PSAP.



Recall that Phase II wireless enhanced 9-1-1 is the level of service which provides the latitude and longitude of the person calling 9-1-1 from a wireless phone. That can be accomplished via a number of different technologies. Each of these is discussed and diagrams are provided for understanding.

3.5.2 Location Determination Technologies

There are 2 general ways to locate a wireless 9-1-1 caller today, they are:

- Network solution
- Handset solution

Each solution is explored below.

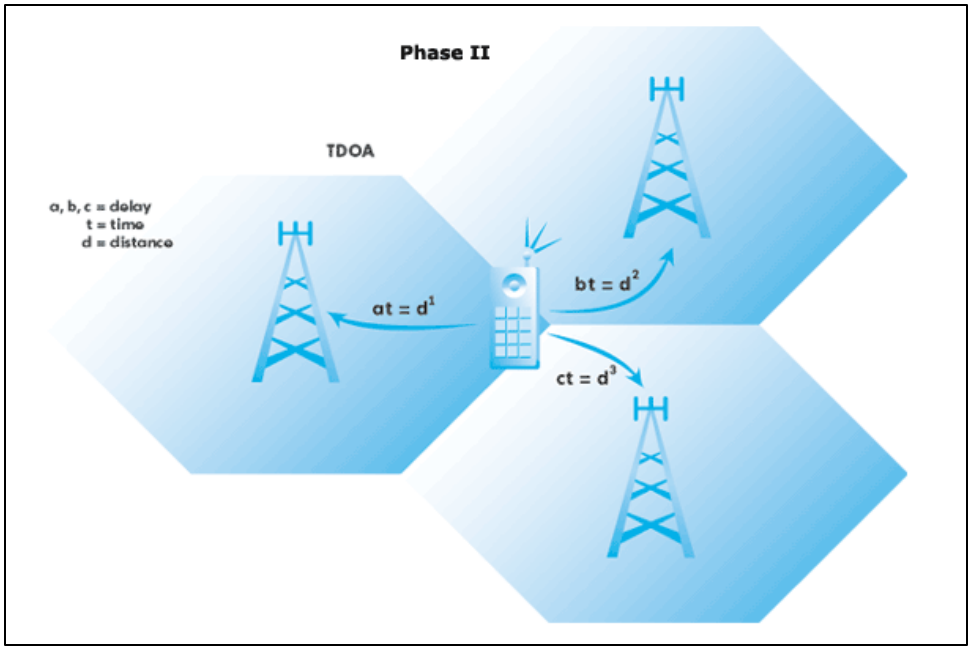
3.5.2.1 Network Solution

One way to locate a caller is to use the network of fixed base stations in a wireless provider's network to triangulate the caller's location. Here's how:

Each station in a carrier's network is outfitted with special radio intercept equipment that receives a signal from any active phone. At any given time, two or more towers are able to compare signals from that phone and locate it based on relative readings. The following are the primary ways wireless carriers can use their network to glean location information.

TIME DIFFERENCE OF ARRIVAL (TDOA)

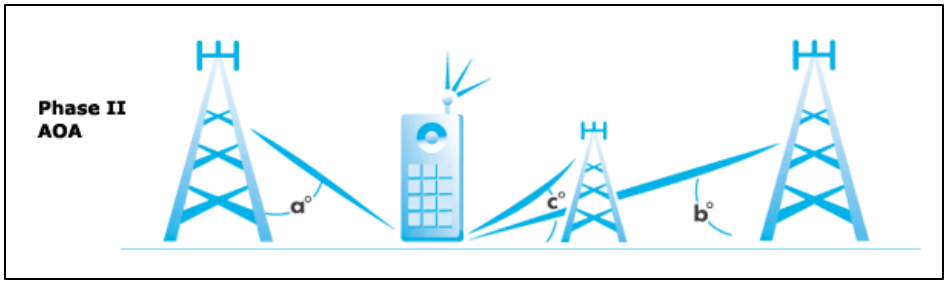
Each tower in a TDOA system is able to measure the amount of time it takes to receive a phone's signal. They can then translate this information to estimate the distance of the phone from the tower. By cross-referencing this information from other towers in the system, a phone's position is expressed in X and Y coordinates based on longitude and latitude readings.



ANGLE OF ARRIVAL (AOA)

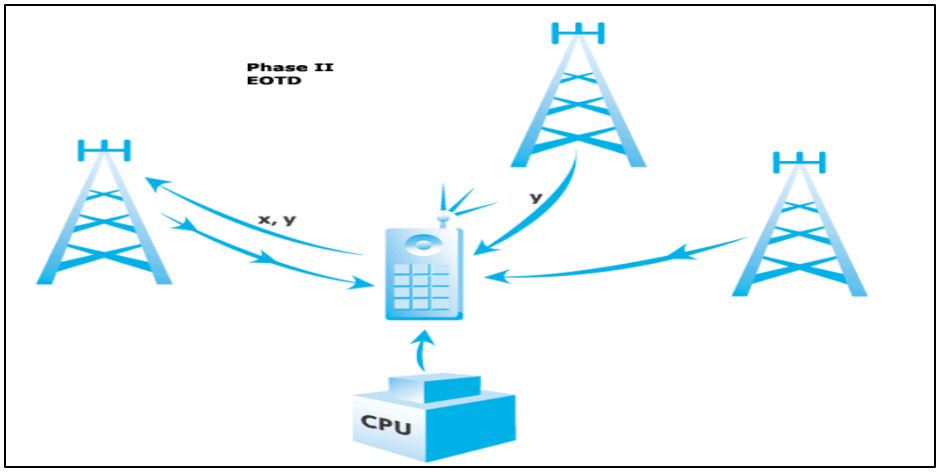
The AOA system uses the antenna arrays at a base station to determine the angle at which a wireless phone's signal arrives at the station. By comparing this angle of arrival data among multiple base stations, the relative location of a wireless phone can also be triangulated. This is also expressed in X and Y coordinates.

Some systems may actually use a combination of TDOA and AOA to get an even more accurate fix on location.



ENHANCED OBSERVED TIME DIFFERENCE (EOTD)

This works much like the TDOA, except the reading is made in the reverse. Instead of a tower making time differential readings, the individual wireless phones have special software installed that receives time-synchronized signals from the towers. They then transmit their location back through the system.



3.5.2.2 *Handset Solutions*

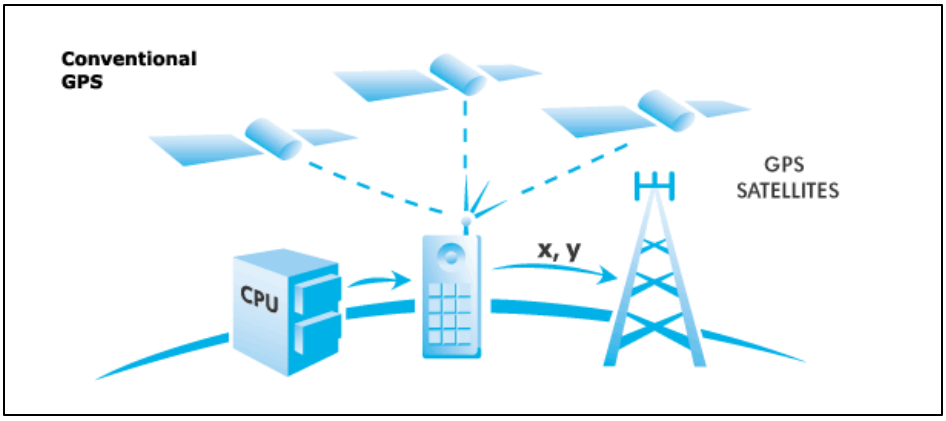
Another way wireless service providers can bring better location technology to 9-1-1 is to use modified handsets that receive Global Positioning System (GPS) signals.

GPS technology uses 24 Navstar satellites that broadcast position and time information to location units on the Earth. Like the triangulation method mentioned earlier, the unit uses information from three satellites to fix its position on the Earth. In the case of the modified handset, this information is sent back through the network, ultimately to the PSAP.

Handsets are able to process GPS readings in the following ways:

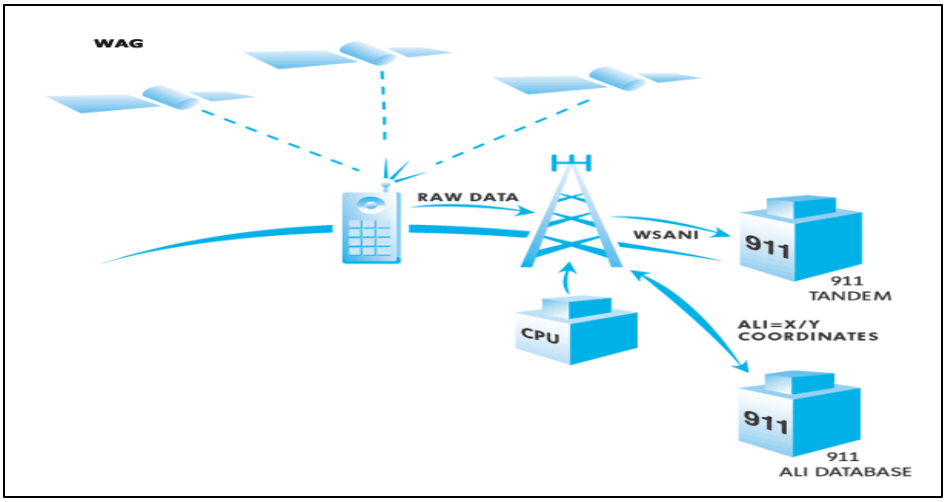
CONVENTIONAL GPS

These systems use modified handsets that receive and process GPS satellite signals without any external assistance.



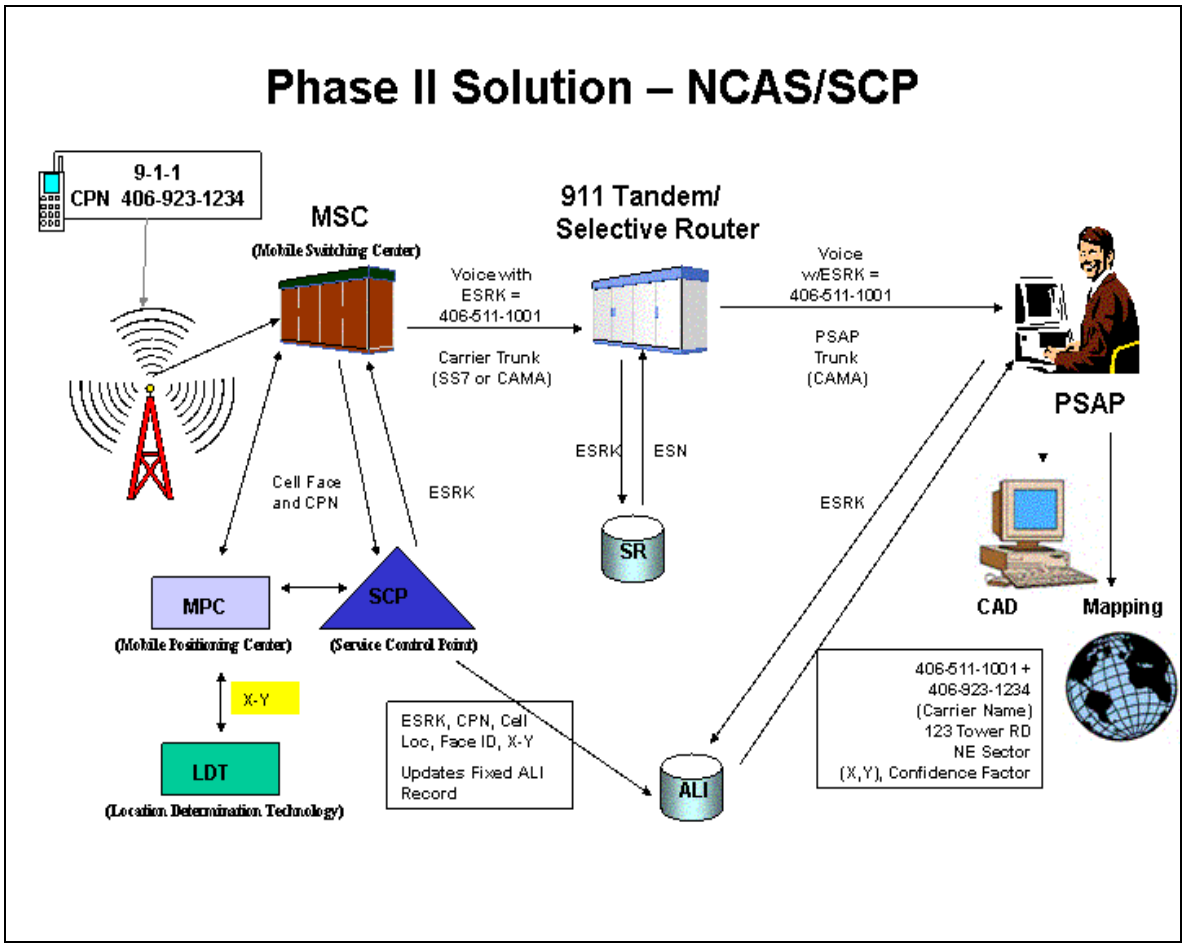
WIRELESS ASSISTED GPS (WAG/A-GPS)

WAG systems use modified handsets that receive GPS signals and then transmit those readings to a computer. This computer then completes the calculation process, relieving the phone of having to process complex location information. With the extra computing strength, the system can use multipath mitigation and signal processing techniques to locate phones indoors, in urban canyons or other places that are a challenge for conventional GPS.



3.5.3 Phase II Wireless 9-1-1

The diagram below illustrates the call flow of a Phase II wireless E9-1-1 call. Notice that the location information and the function of determining that location are shown on the diagram.



Wireless 9-1-1 will, over time, become the way most people will dial 9-1-1. The transition from landline or wireline telephones to wireless phones is happening, and will only increase in the coming years as people use a wireless phone as their only phone.

The implementation of a statewide system for enhanced 9-1-1 services will prepare PSAPs that are not capable of handling wireless 9-1-1 calls to process these calls, and provide them with this capability in a very timely manner. PSAPs will be enabled to handle wireless 9-1-1 much faster with a statewide solution as opposed to the natural transition that occurs today. A statewide system will speed the transition and migration to enhanced 9-1-1 services, and provide for better public safety.

4. SYSTEM ALTERNATIVES

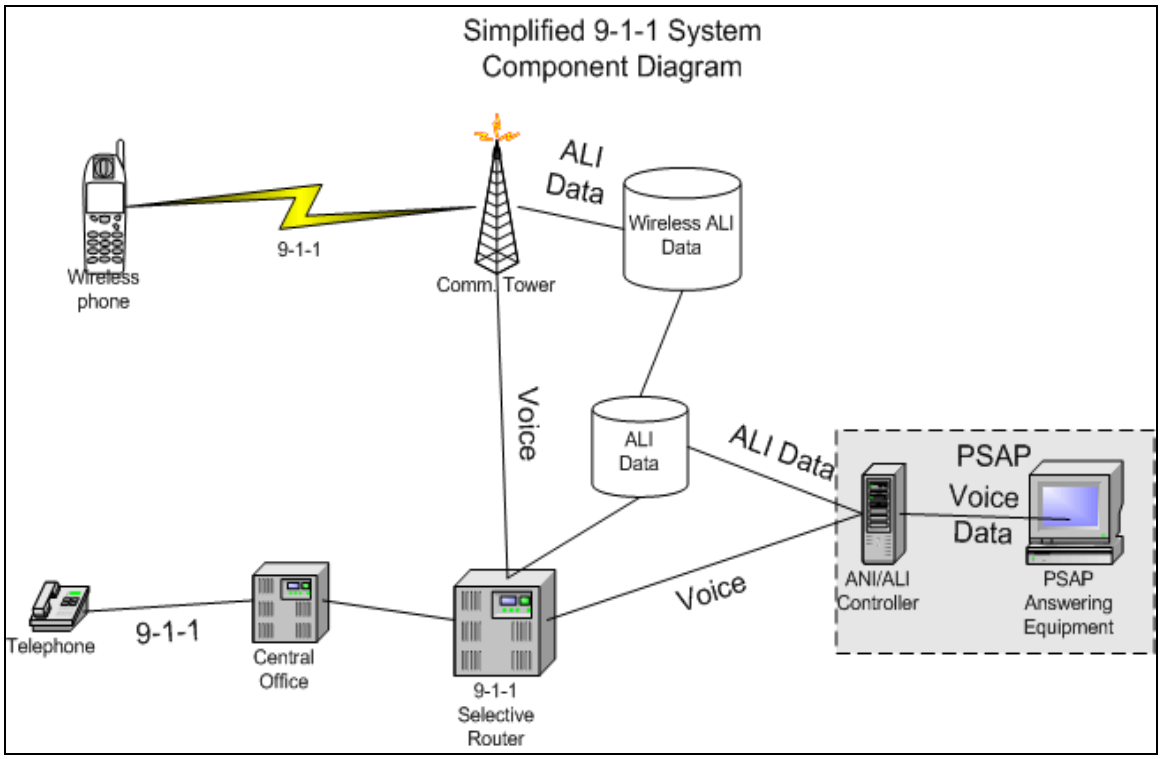
In the 9-1-1 industry today, there are two (2) general models that can be used to discuss, compare, and contrast any statewide 9-1-1 system that might be proposed for Montana. These 2 models are:

- Regional
- Centralized

Either model shares common functions which can be defined and discussed, they are:

- Selective Routing functions
- ANI/ALI controller functions
- ALI database functions
- Network connectivity

This simple diagram will help explain these functions.



Selective Routers perform the function of routing a 9-1-1 call to the correct PSAP, and are considered critical components of any E9-1-1 delivery network.

The current Wireline and wireless 9-1-1 network in Montana supports 16 out of 58 PSAPs with Enhanced 9-1-1 services (E9-1-1). These 16 PSAPs are supported by 4 different Selective Routers (S/Rs).

Selective routers would be a critical component of any statewide system implemented in Montana.

ANI/ALI Controllers coordinate the presentation of a 9-1-1 call with Automatic Number Identification (ANI or telephone number) with Automatic Location Identification (ALI or address) data at the PSAP. The ANI/ALI Controller function is considered an essential component of any enhanced 9-1-1 system.

There are two general types of ANI/ALI controllers commercially available, they are:

- On-site or premise based
- Remote based

On-site ANI/ALI controllers require that the 9-1-1 answering system and the equipment functioning as the ANI/ALI controller be located within the same PSAP building.

The remote type of ANI/ALI Controller supports both the voice and data requirements of a 9-1-1 call and can support answering positions that are remote or geographically separate from the ANI/ALI Controller. In this type of configuration, the remote workstations are typically linked to the ANI/ALI Controller over dedicated leased circuits.

Automatic Location Identification (ALI) Database provides critical address or location information to a PSAP of a 9-1-1 call. This function does not occur in basic 9-1-1, but is a critical component of any enhanced 9-1-1 system.

In its simplest form, ALI is the information presented to a PSAP which enables 9-1-1 call takers to dispatch emergency response agencies to a 9-1-1 caller's location.

In a statewide system designed to accommodate all forms of 9-1-1, there are further distinctions of ALI database functions that can be made, they are:

- Wireline or landline ALI
- Wireless ALI

Ultimately each of these perform the same basic function; provide the location of a 9-1-1 caller, but exactly how the information gets to the PSAP is different. Each is explained below.

Wireline ALI

Wireline ALI records originate from the LEC or CLECs Access Line subscriber billing information. This data is compared to a Master Street Address Guide (MSAG) that has been develop by the County or City and serves as a filter or screen for information passed to PSAPs.

An MSAG valid address becomes a critical piece of information when responding to emergency situations. MSAG valid addresses are only possible if a municipality has performed addressing. Transitioning from basic 9-1-1 to enhanced 9-1-1 is often the event which requires municipalities to perform municipal addressing.

Addresses which pass MSAG validation become the ALI database for a given municipality. An ALI database is constantly updated and modified as citizen's move, change service or change telephone numbers. Once established, the ALI database function becomes a maintenance function.

Distribution of ALI data is usually provided to PSAPs over leased circuits from a central location. Due to the critical nature of 9-1-1 and the value ALI data represents, normally two (2) lease lines are provisioned to enable redundancy and failover capability.

Storage of Wireline ALI data is generally provided by the LEC.

Wireless ALI

Wireless ALI records are presented and controlled in the same way wireline ALI is, and also conveys the same critical information. But, the information is provided in a completely different fashion than that described above.

Wireless ALI data is not stored; it is dynamically generated each time a caller dials 9-1-1. The wireless carriers rely on a combination of information provided from their networks at the time of the call coupled with data that is generated by a 3rd party database provider (TCS or Intrado) to populate the ALI record and present it to the PSAP.

Wireless ALI records contain the Pseudo Automatic Number Identification (pANI) of the wireless 9-1-1 caller's Radio Tower, the wireless callers call back number, the address of the tower that received the call and, if Phase II, the Latitude (Lat) and Longitude (Long) of the caller when they dialed 9-1-1.

Wireless ALI follows the same data protocol and format as Wireline ALI with the exception of the additional data fields that contain the Lat and Long for Phase II.

The serving of wireless ALI data is done through the combination of traditional ALI databases connected to wireless 3rd party data vendors. Wireless ALI data generation is the sole responsibility of the wireless carriers and 3rd party database providers, but dedicated data links to these providers is required.

Network

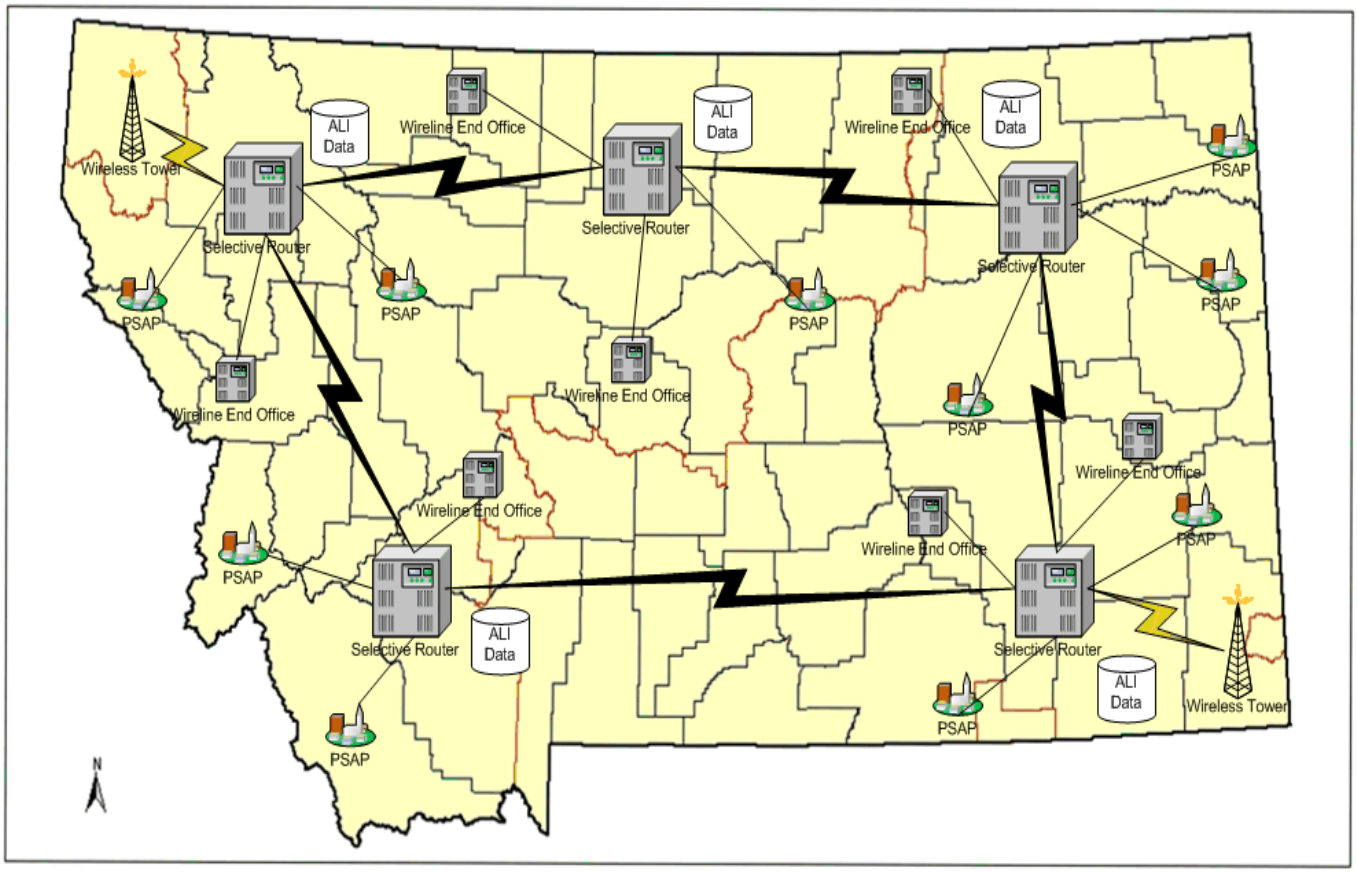
When we discuss network, we are referring to the leased line facilities that provide all of the connectivity between S/Rs, PSAPs, Telco Central Offices, ANI/ALI Controllers, and ALI database sources.

In the diagram above, the network is represented by the lines which connect all of the 9-1-1 system components together.

4.1 REGIONAL 9-1-1 NETWORK MODEL

4.1.1 Overview

Regional Conceptual Model



The diagram above depicts a regional 9-1-1 network model conceptual diagram. It illustrates some essential concepts and characteristics that are part and parcel to the definition of a regional 9-1-1 system model.

The characteristics which define a regional model are:

- Regional selective routing (S/R)of 9-1-1 calls
- PSAPs in the regions are connected to the same selective router which enables easy transfer of misrouted 9-1-1 calls
- The ANI/ALI controlling function is not required at the PSAP locations, it can be performed at the S/R or at the PSAP
- Regional S/Rs can be connected to other regional S/Rs to provide backup, load balancing and re-routing of misrouted calls across the entire system.

- The network used to link the regions together could be used as network aggregation points which in turn could reduce overall network costs.
- Circuit costs can be reduced due to shorter distances a circuit would have to traverse in order to connect PSAPs to the network and End Offices of the telephone companies to the network.
- Problems in one region do not affect other regions or the entire system, they can be localized

4.1.2 Regional Selective Routers

In a regional model, S/Rs would be located in regional areas and would provide service to those regional areas for 9-1-1. In general, calls that originate in that region stay within that region.

PSAPs in the region are connected to the same S/R which enables easy and timely transfer of calls that may have been misrouted to the incorrect PSAP. This is a common occurrence in wireless 9-1-1 today.

The robustness of the actual equipment used to perform S/R can be scaled down in terms of capacities and processing power. The regional model generally entails fewer connections than would be required if the function were being performed on a statewide basis.

Regional S/Rs would be networked together so that the ability exists to transfer calls system-wide, and in order to re-route 9-1-1 calls in the event of a regional system or PSAP failure.

Regional S/Rs will also support the deployment of wireless 9-1-1 services by the wireless carriers in Montana. Most of the wireless carriers in Montana are regional, having a regional S/R to connect to should ease and facilitate wireless 9-1-1 deployment.

In addition, having the S/Rs in a geographic region would allow the central offices in that region to connect to the 9-1-1 system. The regional model compliments the current and existing landline telephone networks which are regionally based.

4.1.3 Regional ANI/ALI Controllers

The function of controlling ANI/ALI information in a regional model is generally more flexible than in other models.

The majority of PSAPs in Montana are 1 and 2 position PSAPs, and the majority of these are only providing basic 9-1-1 services today. As stated in Section 2, 42 PSAPs would need to facilitate some kind of ANI/ALI controlling function in order to transition to enhanced 9-1-1 services.

There are commercially available S/Rs which also can perform ANI/ALI controlling functions and pass this information along dedicated lines to PSAPs configured as remote workstations. This alleviates the potential requirement to outfit every PSAP with hardware and software to perform ANI/ALI controlling functions.

This would not have to be an all or nothing configuration either. In other words, PSAPs that have already purchased and installed an ANI/ALI controller would not need to change equipment or configuration. They could operate in this model the way they do today. The regional approach offers the flexibility to have PSAPs configured either way.

4.1.4 Regional ALI Database

The function of the ALI database in a regional model can be very flexible and amenable to specific requirements. In general, ALI databases can be located anywhere in the system as long as they have connectivity into the entire network.

A regional model for ALI databases is usually characterized by regional ALI databases designed to serve that region.

Regional ALI databases allow for regional maintenance and upkeep of addressing information in the region where the addresses are located. From a management and maintenance perspective, this could be done easier and simpler if staff from and familiar with the region are maintaining the records of the regions.

Typically in this sort of arrangement, regional ALI databases would serve as backup copies to other regions, and could take over the functions of other regions in the event of system or component failure.

4.1.5 Regional Network and Connectivity

A general characteristic of the regional model is that network costs can be reduced by the simple fact that distances circuits must be run to provide connectivity is regional, not across the state.

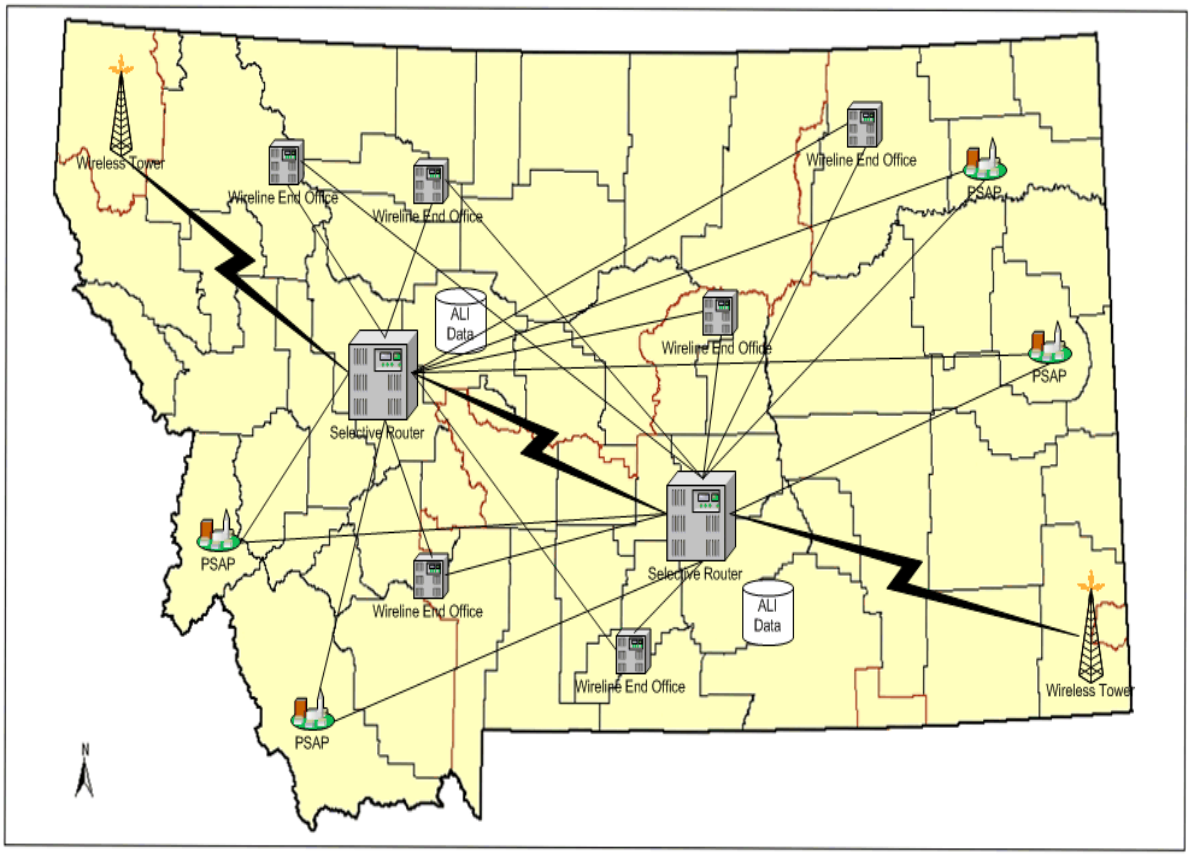
Therein lies a major appeal in this model. The regional S/Rs can act as aggregation points which collect all connections to them and provide connectivity to the rest of the system. Because the S/R is geographically close to all facilities that need to be connected, the costs of doing so are much less.

It is also easier to build in or design redundancy and diversity of circuitry at the regional level.

4.2 CENTRALIZED 9-1-1 NETWORK MODEL

4.2.1 Overview

Centralized Conceptual Diagram



The diagram above depicts a centralized 9-1-1 network model conceptual diagram. It illustrates some essential concepts and characteristics that are part and parcel to the definition of a centralized 9-1-1 system model.

The characteristics which define a centralized model are:

- Centralized selective routing (S/R)of 9-1-1 calls
- PSAPs all across the state are connected to the same selective router which enables easy transfer of misrouted 9-1-1 calls
- The ANI/ALI controlling function is almost always performed at the PSAP by on-site equipment
- Centralized S/Rs are connected to each other to provide backup, load balancing and re-routing of misrouted calls across the entire system.

- All PSAPs, Central Offices and wireless carriers are required to connect to these central locations

4.2.2 Centralized Selective Routers

Centralized S/R is generally performed at one or two geographically central locations. It also usually occurs in what are termed mated pairs or 9-1-1 tandem S/Rs. In this model, typical S/R functions are shared between two similarly configured S/Rs which back each other up and will take over S/R functions in the event of failure.

Connections to each S/R are typical for redundancy and failover.

PSAPs across the state are connected to the same S/R which enables easy and timely transfer of calls that may have been misrouted to the incorrect PSAP. This is a common occurrence in wireless 9-1-1 today.

All wireless carriers would have to connect both selective routers and the S/Rs become the common interface point to the 9-1-1 system.

Typically, these S/Rs are robust in nature and are designed from a capacity perspective to handle large volumes of calls across a large geographic area.

4.2.3 Centralized ANI/ALI Controllers

In a centralized model, ANI/ALI controlling is done almost exclusively at the PSAP. This is done primarily to segregate this critical function from the S/R function which is also being done centrally, with the idea being that the S/Rs are performing this function state or system wide. The scenario of on-site ANI/ALI controlling is typical in the industry.

4.2.4 Centralized ALI Database

In general, ALI databases can be located anywhere in the system as long as they have connectivity into the entire network. Most systems of this sort are connected to National ALI databases which often times are not geographically located with the S/Rs or even within the boundaries of the state or municipality being served.

4.2.5 Centralized Network and Connectivity

In general, the network connectivity for this type of model tends to come at a higher cost. This is due to the distance some connections have to traverse in order to connect to the system.

4.3 COMPARISON OF CENTRALIZED VS. REGIONAL

We will now compare the two models and provide pros and cons of each as they compare to each other, and how each model may apply to a statewide solution in Montana.

Selective Routing (S/R)	
Centralized	**Regional**
All S/R would be preformed in geographically central locations with leased lines being utilized to connect all Central Offices to the S/R. All wireless carriers would be required to connect to the central S/Rs. All of the PSAP would need to connect to the central S/Rs.	Small S/Rs placed in various locations throughout the State which serve only Central Offices, PSAPs and wireless carriers in that region. Every central office in the state would not be required to connect to all regional S/R nor would all wireless carriers or PSAPs not being served in that region.
Pros Allows for simpler design for disaster recovery solutions, 1 or 2 locations to fail versus multiple. Easier to support and respond to problems at 2 locations versus multiple. Potentially less connections for Wireless Carriers. Lower overall maintenance costs as opposed to multiple S/Rs.	**Pros** Allows for design that would support a small geographic area. Potentially lower circuit costs for connecting wireline and wireless carriers. Regional S/Rs are not required to be as robust or as capable as S/Rs that would be designed to handle the entire system. Multiple failover and backup scenarios possible given increased number of S/Rs. Failure in 1 region is less likely to affect other regions and or the entire system. Could improve call delivery times by keeping calls that originate in the region in the region.
Cons Cost to connect across the vast geographic distances represented in Montana may be too high. Component or system failures could affect entire system.	**Cons** May require higher and more dedicated support levels. Increases the number of failure points in the entire system.

	More equipment to maintain, monitor and support in multiple locations.

Recommendation

Kimball believes that regional S/R model offers the most flexibility and scenarios for success than a having this function located and operated centrally. The regional model represents the best fit for any proposed system in Montana despite the potential for higher levels of maintenance, equipment, support and points of failure.

The regional S/R model holds the highest potential for lower circuit costs, the ability to localize failures, and provides the potential for cost savings at the PSAP level if the ANI/ALI controlling function is included with the S/R.

ANI/ALI Controller

Centralized	Regional
Each PSAP would require it's own ANI/ALI Controller due to the typical segregation of these functions in higher capacity S/Rs.	Regional ANI/ALI controllers could be part and parcel to the S/R functions and could be shared between PSAPs that may only have 1 or 2 positions.
Pros Provides flexibility to PSAPs in determining what equipment they have to on-site to perform this function. Problems or failures of the ANI/ALI controller are localized to the PSAP. On-site controllers easily support non-9-1-1 or admin lines on the same PC Workstation in an in the PSAP.	**Pros** Easier to maintain and provide support to fewer ANI/ALI controllers system wide when compared to a controller at each PSAP. Off Site locations for the ANI/ALI controller can be chosen that may already have hardened facilities (Emergency Generator, UPS) that would more suitable to support critical ANI/ALI functions. Common ANI/ALI controllers could support multiple PSAPs and share the costs over a greater number of PSAPs / Workstations. Common ANI/ALI controllers should offer a lower cost per Workstation upgrade when future features are available. Common ANI/ALI controllers offer mutual support features between PSAPs such as automatic failure forwarding to predetermined destinations and 9-1-1 call forwarding. Redundant ALI Links via Telephone facilities would only need to terminate on the ANI/ALI Controllers saving the need to provision ALI

	links to each PSAP. Common ANI/ALI Controllers would be able to economically support high speed networks such as SS7, verses each PSAP installing a high speed solution. Off Site generally requires less PSAP equipment room space availability and smaller UPS systems.
Cons Requires each PSAP to have redundant ALI links generally (2) analog or digital channel. On-site ANI/ALI controller may not be economically feasible in many of the 1 or 2 position PSAPs. As updates are available such as VoIP, each ANI/ALI Controller would require some type of upgrade. Each PSAP with an on-site controller would require service and support on-site if problems arise.	**Cons** Remote workstations require multiple telephone facilities per workstation to link the remote ANI/ALI Controller. This will come at a cost which is not required by an on-site solution. The type of Telephone Facilities that are generally required to support off-site Workstation need to cleanly support voice and data or service issues will surface. Adding a PSAP local telephone line to the Workstation, is generally very expensive since the local telephone would be to be terminated on the ANI/ALI Controller at the distance location. CAD system integration would also be more costly, if the CAD port was only supported via the ANI/ALI Controller.

Recommendation

There are (46) 1 or 2 positions PSAPs in Montana that may be able to utilize a Common ANI/ALI Controller. Large PSAPs may be best served by having their own ANI/ALI Controller at their locations.

Kimball believes that a significant costs savings would be possible if regional ANI/ALI controllers were utilized in any future system design. We believe that a regional ANI/ALI controller solution may be very suitable for a majority of the small 1 or 2 position PSAPs in Montana.

A regional ANI/ALI controller solution also provides the flexibility to the PSSO and PSAPs to utilize already existing equipment if capable and installed.

Automatic Location Identification (ALI)

Centralized	Regional
Most systems of this sort are connected to National ALI databases which often times are not geographically located with the S/Rs or even within the boundaries of the state or municipality being served.	Regional ALI databases designed to primarily serve that region.
Pros Centralized support and maintenance. Function of daily updating and maintenance of records is taken care of elsewhere costs for support personnel would typically be included. Fewer connections to 3rd party wireless database providers would be required.	**Pros** Allows for design that would support a small geographic area. Potentially less circuits for ALI links to individual PSAPs. Interruptions in other locales would not effect ALI distribution from regional S/Rs and ANI/ALI controllers. Increased backup and redundancy if regional ALI databases are designed to share data. More control over the maintenance and accuracy of the ALI records.
Cons Circuit Mileage to transport all S/R and ANI/ALI Controllers would create the need for an independent "data" type network. This could be very costly to the small PSAP that only support a limited number of 9-1-1 annually.	**Cons** More systems to maintain and support. Could require increased staffing levels. May require more connections to 3rd party wireless database providers. Daily update and maintenance function becomes decentralized.
Recommendation Kimball believes that the regional model again wins out in terms of fit for the PSSO. A regional ALI database solution provides more flexibility, control and protection from failure or disaster than the centralized model.	

Network	
Centralized	**Regional**
The centralized model generally entails connections from all wireline central offices, PSAPs and wireless carriers to typically 1 or 2 geographically central location	The regional model generally requires network connections from PSAPs, wireline central offices, and wireless carriers located in that region.
Pro Fewer points of failure in the network. Simpler design and maintenance. Easier to monitor network connections into and out of the S/R. Fewer connection points required for wireless carriers providing coverage statewide.	**Pro** Smaller circuit distances required to connect all components together. Lower connection costs due to smaller distances to cover. Impact from failure usually contained to the region and does not affect entire system.
Con Longer circuit distances required to connect to all components across the state means increase in costs required to connect.	**Con** More complex design could translate into higher levels of support and maintenance. More potential points of failure.
Recommendation Kimball believes that the overall cost savings that can be realized in the regional network model will far outweigh the costs required for a centralized model.	

Each of the models presented and analyzed above afford benefits, protections costs savings in certain areas and when applied properly can enable the efficient and effective processing of all forms of 9-1-1 calls.

Kimball believes that given the current conditions in Montana, the geographic distances involved, and the current level of most PSAPs across the state, that the regional model as described above stands the best chance of success if applied as described.

The regional model offers the most flexibility in design and implementation as well as flexibility in implementation or build out of this system across the state.

4.3.1 Variations

There is really only one variation of the models explored above which may be feasible in Montana today. That is to build a regional system which upgrades those PSAPs providing basic 9-1-1 services today and interconnect to the existing systems which already provide enhanced 9-1-1 services today.

This would take on the form of a hybrid solution, but one which could allow the PSSO to focus resources and effort on the locations that require it the most. It could also provide a cost savings to the overall project by not attempting to re-create or overlay systems that already exist.

In Montana today, there are 4 selective routers serving regions of the state, they are:

- Century Telephone in the north west corner
- NEMONT in the north east corner
- Qwest east and west serving most of the population centers of the state

A regional approach to a statewide system could utilize these existing systems and networks as part of an overall solution. It is Kimball's' position that a regional approach would be the only model that could do this.

4.4 POTENTIAL IMPLEMENTATION STRATEGIES

If a regional model is adopted by the PSSO as the conceptual design for any future system, the following implementation strategies can be followed:

- Issue an RFP with specific technical specifications to solicit designs and solutions that satisfy the goals and requirements of the PSSO as stated in this report
- Continue to develop and foster PSAP community support for the statewide initiative
- Design and implement a pilot region
- Use lessons learned from pilot to do a phased implementation by region
- Implementation can be done in parallel yet remain independent

5. APPENDIX A – EMERGING TECHNOLOGIES

5.1 EMERGING TECHNOLOGIES

5.1.1 VoIP

VoIP provides a method of accessing data networks such as the internet or other public or private networks to make telephone calls. VoIP converts the voice signal from your telephone into digital packets that travel over the internet then converts it back at the other end so you can speak to anyone with a regular phone number. When placing a VoIP call using a phone with an adapter, you'll hear a dial tone and dial just as you always have. VoIP may also allow you to make a call directly from a computer using a conventional telephone or a microphone.

5.1.2 Virtual Locations and Mobility

For the most part, traditional circuit-switched telephony is based on linking the end-points (i.e. phones) to the PBX/switch using a dedicated, hard-wired connection. Through the use of patch-panels, distribution centers, wiring closets, etc., cabling is required which provides call control and media transport services to and from the phones. While some capabilities do exist that allow wired analog and digital phones to "dynamically" move from place to place without reconfiguration at the PBX/switch level, for the most part, current residential and business telephony infrastructures require that a particular phone remain connected to a particular cable unless such configuration changes are performed.

With VoIP, this is no longer a restriction. For business and residential IP Telephony service, it is not only possible to easily move IP end-points from place to place; it is one of the marketed benefits. With IP Telephony, an end point only needs to have IP connectivity with the IP Communication Server or SIP Proxy Server and the IP end-point(s) that they will be communicating with. For example, a business user with an IP phone that is connected to an IP Communication Server can simply unplug their phone from the network, walk down the hallway, or even, to another building, plug the phone back into the network, and they will be able to immediately use that phone. This example assumes that the new location where the IP phone is plugged into can provide access back to the Communication Server. For residential users, this mobility can extend to virtually anywhere that the Internet is available.

While this mobility offers many advantages, it also creates a real problem when trying to respond to a person making an emergency call from one of these phones. Because IP phones and end-points can be so mobile, the ability to utilize the current E-911 technology and infrastructure to accurately locate a caller and route the emergency call to the appropriate PSAP can be challenging or even impossible.

5.1.3 IP Telephony Architecture Options

One of the challenges with IP Telephony is that it must, in many cases, integrate into existing traditional telephony infrastructures that exist today. Based upon specific goals and needs, there are three different approaches to begin integrating IP Telephony into their current telephony infrastructure.

1. Trunk replacement (Conventional trunks to IP based trunks)
2. Integration Points / Hybrid (Conventional trunks to interface conversion device)
3. IP Trunks end to end

In many cases, an organization will utilize more than one of the approaches to meet all of the IP telephony requirements within their enterprise.

5.1.4 Methods of Usage

Businesses have a number of options that they can choose when implementing IP Telephony. These options will depend on their specific business goals, current telephony infrastructure and level of expertise. The three primary options for business are; replace their PBXs, extend their PBXs, or utilize a 3rd party to provide IP Telephony services (IP Centrex). For residential users, the option now exists to use a broadband connection to the Internet for their telephony services.

5.1.5 Residential Service

Over the past few years, a growing number of residential users have begun using the Internet as one of their methods for voice communications. Initially, this was accomplished by software such as MS Net Meeting and Net2Phone. This software allows the residential user to utilize their home computer, connected to the Internet, to receive and place calls to/from other users with similar software. The users use the speakers attached to their computer or a headset to listen and a microphone connected to their computer to talk.

Soon after, a number of companies begin offering residential users a service that would allow them to place/receive calls with others who have a traditional phone connected to the PSTN. This was provided through the use of IP gateways, which can route the call from the Internet to the PSTN and vice-versa. With this approach, users still use the speakers attached to their computer or a headset to listen and a microphone connected to their computer to talk.

Recently, a number of companies have begun offering a service that works very much like the telephone that people have in their home today. A residential customer can pick up the phone, dial the number and it connects to whom they are calling. In more technical terms, this service uses the phone adapter, known as an Analog Telephone Adapter (ATA) or Multimedia Terminal Adapter (MTA) to convert the analog signal to a digital signal. The digital signal then can be sent over a high speed (i.e. cable, DSL) Internet connection. Residential customers can get a new phone number or can keep the existing number (number portability). On-net call (calls between locations connected to the Internet can be free of charge; off-net calls are delivered to the PSTN network using IP gateway devices, with Least Cost Routing (LCR) functionality.

When someone calls a residential customer with this service, they dial a standard telephone number. Behind the scenes, this number looks very much like an e-mail address. This number instructs the call to travel over the Internet and through the network to the ATA. The phone connected to the ATA rings. From that point, the rest of the call is identical to a phone call made using an analog phone directly connected to the PSTN, via a Local Service Provider.

VoIP promises lower costs and is beginning to generate a buzz. Any 9-1-1 network being discussed today must be capable of handling 9-1-1 calls from VoIP systems or networks, and ensure they are routed to the proper PSAP for response.

Any RFP put together by the PSSO must be capable of interfacing with VoIP networks, and be capable of routing VoIP 9-1-1 calls and associated data to the correct PSAP.

5.1.6 Automatic Crash Notification (ACN)/Telematics

Telematics are a group of services, some of which are location-based, involving various types of notification and assistance to the owner/operator of a vehicle, emergency services, and commercial convenience services. To gain access to these services the vehicle must have Telematics hardware installed and contracts between the user and the Telematics firms must be enacted enabling the consumer to receive the requested services.

The OnStar service by GM is an example of Telematics type services.

Telematics devices are available as original equipment on some new vehicles or as add-on equipment using aftermarket devices. Telematics services are provided by dedicated call centers which are under contract with the equipment manufacturer or automaker. Subscriber agreements are required to use these services. The manufacturer or automaker designates services and their elements. Subscribers then choose which of the offered services they desire to utilize.

5.1.7 Telematics Services

A variety of services are available through Telematics suppliers. Some services are only available using specific equipment and/or service vendors. Generally the services fall in five categories: emergency, navigation, convenience, vehicle, and dealer/manufacturer services. The following list identifies typical services in each category:

5.1.8 Emergency Services

- Mayday Calls – Occupant pushes button in car to summon help
- Automatic Collision Notification – Call is initiated by collisions forces, without occupant intervention, usually air bag deployment or seat belt tensioning system deployment.
- Roadside Assistance – calls for tow trucks, gasoline, tire replacement, etc.
- Stolen Vehicle Tracking

5.1.9 Navigation Services

- Operator assisted routing to a known address or business place
- Interactive Voice Response routing to a known address (no operator involved)
- Point of Interest Lookup to find local business or visitor attractions

5.1.10 Telematics Call Centers

Telematics require that highly sophisticated technology be installed at the call center. This technology enables the call center to interface with callers that may be using equipment with multiple communications protocols. The protocols often change between auto makes and year models. The call center telephone equipment must be designed to determine the incoming protocol and provide immediate acknowledgement that is acceptable to the calling equipment to prevent possible loss of the call.

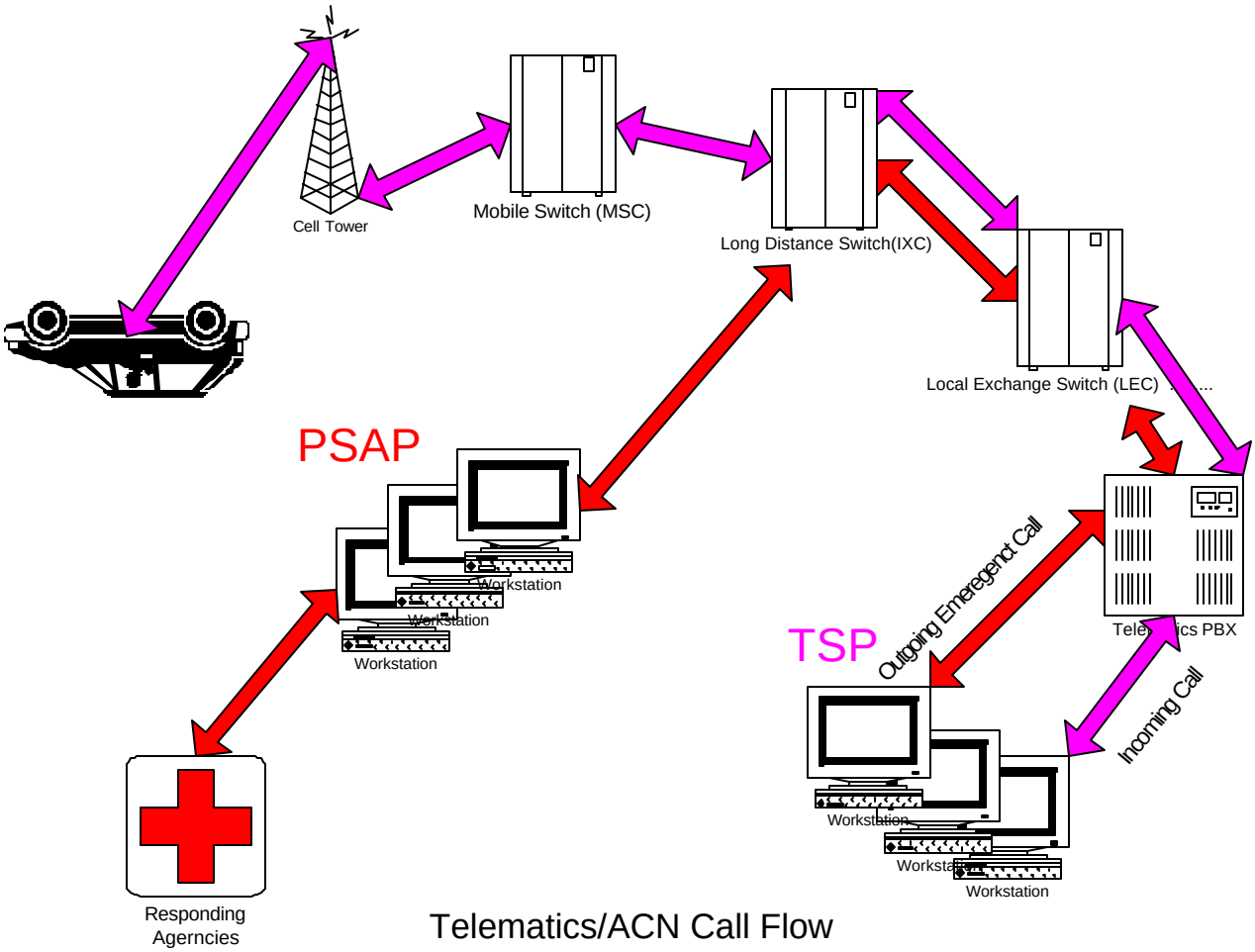
Should the call center become disconnected or lose the call, the telematics equipment in the vehicle will continue to call back to the TSP call center until it is either commanded to discontinue the event by the call center operator or the battery becomes too low to place further calls.

When the in-vehicle equipment and the call center equipment are connected and communicating, ancillary telephone equipment and software must allow database lookup to determine the range of services authorized by the caller(per their subscriber agreement), and validate their agreement is in force Automated Call Director (ACD) capability will allow the call to be routed to an operator possessing the skills needed to handle the incoming call type (e.g. Emergency, navigation, etc). Then the data link must be established to the operator's console so that the voice and data paths coincide.

Simultaneously, the location data (latitude/longitude coordinates) are interrogated to display a map at the console centered on the calling party's location. This map is automatically scaled to display the right combination of detail to help the operator describe the location to 9-1-1, if needed. In the background, the lat/lon data is reverse geocoded against the map database to provide the operator one of the following location parameters; the street address; the street address range or the street/cross street and distance.

Separately, the lat/lon coordinates also are used to determine the nearest or jurisdictionally appropriate PSAPs and/or other public safety dispatch facilities to support this incident. One or more PSAPs or dispatch facilities are listed along with their telephone numbers, which may be auto-dialed by pressing the appropriate command key.

A conceptual diagram of the call flow of a Telematics or ACN event is illustrated on the following page.



Telematics/ACN Call Flow
at the Current Time

Any system being investigated today must take into account the potential impact of services like Telematics, and accommodate the necessary data requirements and capacity necessary to process these types of call.

6. APPENDIX B – OWN VS. LEASE

6.1 OVERVIEW

The purpose of this document is to outline the considerations required of implementing a state owned and managed E9-1-1 solution versus a leased solution. It will cover network, database, customer premise equipment (CPE), mapping display equipment, Maintenance and monitoring, and training.

6.2 NETWORK SERVICES

6.2.1 Network for E9-1-1 Services – Owned

The implementation of a state owned solution would require network connectivity (transport) and interface between the Public Switched Telephone Network (PSTN) and E9-1-1 Network. The network facilities are normally provided by the local exchange carrier (LEC) as a part of the overall solution for E9-1-1 deployment within a jurisdiction. This is not always the case, as some jurisdictions have elected to use dark fiber or build out their own dedicated network. Transport in this discussion is defined as end-to-end connectivity from the PSTN into the E9-1-1 system and back to the PSTN. (This will provide the ability to receive 9-1-1 calls, selectively route 9-1-1 calls to the proper PSAP, transfer calls to other PSAPs, facilitate call routing to other E9-1-1 networks, provide 3rd party database access, alternate call routing, etc.). It is understood in moving forward that the transport mechanism for either solution will be a leased arrangement from the LEC or other qualified transport provider with the capabilities necessary to provide the level of service required by the PSSO.

6.2.2 Network Considerations - Owned

- Transport from LEC central offices to DACS
- Transport from CLEC central offices or switching facilities to DACS
- Transport from PSSO switches
- Transport between switches
- Housing for equipment (E9-1-1 Switches, Selective Routers, Database equipment and associated hardware for 9-1-1 network.)
- Establish trunk IDs
- Establish trunk groups
- Establish Selective routing tables
- Back up data
- Store data
- Manage carrier DACS assignments
- Perform trunk testing
- Establish Alternate Routing plan
- User name and password programming

6.2.3 Network for E9-1-1 Services – Leased

The implementation of a leased arrangement will keep the system very similar to the methodology which exists today for the wire line 9-1-1 system. The only difference would be that the ability to receive wireless 9-1-1 calls with Phase I and Phase II data would become available. It would require additional trunking from the Wireless carrier MSC to the LEC or CLEC E9-1-1 Tandem switch. This would provide the necessary facilities from each wireless carrier to route their traffic onto the network handling calls.

6.2.4 Transport from LEC /CLEC Central Offices - Owned

The trunks will provide connectivity from the PSTN onto the E9-1-1 network. They will run from the originating central office, and terminated independent of one another at DACS locations as determined by the PSSO. End office trunks should be installed in pairs to minimize single points of failure. Capacities can be increased according to CCS count studies and other loading considerations.

6.2.5 Transport from LEC /CLEC Central Offices - Leased

The trunks will provide connectivity from the PSTN onto the E9-1-1 network. They will run from the originating central office, and terminated independent of one another at the 9-1-1 S/R switch locations as currently designed and operating. End office trunks should be installed in pairs to minimize single points of failure. Capacities can be increased according to CCS count studies and other loading considerations.

6.2.6 Network Transport and Topology - Owned

The network should be engineered using Sonet Ring technology (Synchronous Optical Network). This is a “self healing” ring topology that permits the rerouting of network traffic in the event that a circuit would fail. This would provide a high level of availability, minimizing down time due to cable cuts, mechanical failures or other types of outages.

Each PSAP and 9-1-1-switch location would be connected to the Sonet Ring by fiber or copper carrier T-1’s. This is accomplished by using a multiplexer, which permits scaling the available bandwidth into predetermined data capacities. These digital circuits would provide a multiuse path for 9-1-1-call handling and other connectivity needs.

The maintenance and monitoring of the network transport facilities would be the responsibility of the provider and the level of monitoring would be negotiated during the procurement of these services. All hardware and software, including the installation, maintenance and support would be covered under a separate arrangement. This is a consideration that should be noted when considering owning the facilities that are operated and managed by multiple parties. Conflict resolution and management can be contentious if there are not clear lines of responsibility.

6.2.7 Network Transport and Topology - Leased

The network should be engineered using Sonet Ring technology (Synchronous Optical Network). This is a "self healing" ring topology that permits the rerouting of network traffic in the event that a circuit would fail. This would provide a high level of availability, minimizing down time due to cable cuts, mechanical failures or other types of outages. Telephone Companies have varying methodologies in deploying network transport and they are dependant on the available resources that are available in any given area of their network. It would be the providers responsibility to provide documentation and diagrams of the network solution being used to provide E9-1-1 transport services. The maintenance and monitoring of the network transport facilities would be the responsibility of the provider and the level of monitoring would be negotiated during the procurement of these services. All hardware and software, installation, maintenance and support would be covered in a single arrangement. The term would vary according to the requirements of the State.

6.2.8 Network Hardware Locations - Owned

The PSSO would need to select locations suitable for housing 9-1-1-switch gear, network hardware, multiplexers, rack equipment and interface devices. This location should be engineered with space capacities to meet both the initial space requirements and to permit future growth and expansion. The location should have available diverse power from two different power grids, diverse routes for network connectivity from the serving telephone company central office, uninterruptible power supply (UPS), and generator. The location should also be a secure one, which has restricted accessibility, and a 24-hour presence of security personnel if possible. UPS and generators must be sized to handle current and future system loading and permit the on-site storage of fuel, with accessibility to replenish fuel supplies as needed. All of the equipment and considerations listed in this section are normally handled by the LEC when providing 9-1-1 services to a jurisdiction. If the state should choose to own and operate the 9-1-1 network, then they would be responsible for all associated costs and staff necessary to manage it. The possibility exists that other state agencies may be able to provide support in handling some of these management tasks. They would be building maintenance, electrical, security etc.

6.2.9 Network Hardware Locations - Leased

The LEC or CLEC based on their current locations that provide for switching and interconnect facilities for their network would provide locations suitable for housing E9-1-1-switch gear, network hardware, and any other equipment necessary to support the E9-1-1 network. This location should provide diverse power from two different power grids, diverse routes for network connectivity, uninterruptible power supply (UPS), and generator.

6.2.10 Network Build-out and Implementation - Owned

Once the installation of hardware, software and cabling begin, a naming convention will need to be developed and documentation of all network and system components must be developed. The information contained in this documentation will serve as a technical reference for all

components (hardware, software, trunks etc.). Once implementation of the system is completed, a contracted entity or PSSO staff would be able to operate and manage the network.

In a contract arrangement, coverage is normally provided Monday through Friday 08:00AM through 5:00PM having on site coverage, and after hours on call support for nights, weekends and holidays. Although this service may be contracted, it would still require PSSO staff participation. Staff would assist with the initial setup, implementation, and support the day-to-day operations. The documentation will provide the agency with a foundation with which to work from and assist in affecting repairs, planning and implementing upgrades to hardware and software.

If PSSO staff handled maintenance, then consideration on impact to the agency must be considered. This would include personnel, training costs, maintenance, support, spare parts inventory and availability. This will be discussed later in the Maintenance and Monitoring section of the document.

6.2.11 Network Build-out and Implementation - Leased

The LEC or CLEC would be responsible according to the contracted arrangements for build out and implementation of E9-1-1 services. Unless specifically specified by the PSSO, naming conventions for all network and system components are developed by the LEC or CLEC, as it would correspond to their facilities. Unless specified in the lease arrangement, the documented information is normally maintained and archived by employees of the LEC or CLEC. In this type of arrangement, coverage is normally provided 24 hours a day seven days a week. It does not provide for on site coverage unless specified in the contract.

6.2.12 Database Services - Owned

The database services are currently handled by the LEC. In this process they have established a database of all customer telephone records and act as the interface with all other carrier and service providers who provide wire line service and future wireless calls. The proposed solution would remove that process from the LEC, thus making the database and all associated hardware a PSSO function and responsibility. The ALI databases, like the 9-1-1 switches will be diversely located at locations chosen by the PSSO for redundancy. In assuming this role, the PSSO will need a Database manager or coordinator and support staff that will take over and maintain the Master Street Address Guide (MSAG), interfacing with municipal coordinators for addressing updates, resolving conflicts, and building new information into the files. This group will also be the interface between the PSSO and all Wire line and Wireless carriers. A methodology must be established for the initial loading of the ALI database, and the receipt of daily updates, moves, adds, deletions etc. to maintain an accurate and up to date E9-1-1 ALI database.

6.2.13 Database Considerations - Owned

- Housing E9-1-1 Database Hardware.
- Redundant Power (UPS, Generator)
- Maintenance of Hardware
- Maintenance for Software
- Network Connectivity

- Initial Loading of ALI data
- Build ESN tables
- Build Selective Routing (SR) tables
- Back up data
- Store data
- Review / scrub ALI data
- Perform Error reconciliation with various carriers
- Interface with new carriers (Provide current MSAG)
- Research ALI discrepancies, misroutes, No record found ALI
- Support PSSO management and PSAPs with database issues
- Assist with system testing verifying (Routing of calls, correct
- ESN's and proper ALI display.)

6.2.14 Database Services - Leased

The database services are currently handled by the LEC. In this process they have established a database of all customer telephone records and act as the interface with all other carrier and service providers who provide wire line service and future wireless calls. Under this arrangement, the PSSO staff and PSAP personnel need only submit corrections to identified errors, update address ranges as they change, provide information on new addresses, new street names and emergency service provider changes for entry into the MSAG.

6.2.15 Database Considerations –Leased

- Accuracy of data
- Network Connectivity
- Perform Error reconciliation with various carriers
- Research ALI discrepancies, misroutes, No record found ALI
- Support PSSO management and PSAPs with database issues

6.3 CUSTOMER PREMISE EQUIPMENT (CPE) AND MAPPING DISPLAY EQUIPMENT

Once the CPE equipment is installed, tested and cutover for operations, the considerations in an owned environment include future hardware upgrades, software upgrades, peripheral device upgrades, and maintaining an adequate level of spare inventory both in parts and complete systems to maintain operational stability.

The equipment will require routine maintenance of hard disks, CPUs, keyboards etc. to help keep the equipment in good working order. Resource management on the CPE will include programming speed dial lists, one button voice and data transfers, TDD canned messaging, screen layouts, adding or deleting system resources etc. The PSSO could utilize in house staff, train PSAP personnel or contract with a vendor to handle these services.

6.3.1 CPE Considerations

- Hardware upgrades
- Software upgrades
- Disk Maintenance
- Resource allocation changes
  - Speed dial programming
  - One button transfer programming (both voice & data)
  - TDD programming
  - Screen layout and sizing
  - Configuration file management
- File Maintenance
- Configuration backups

When this equipment is leased and not owned, it is likely that the state would be required to use equipment for the life of the lease unless upgrade provisions are included in the lease. If the state owns the equipment, it can be upgraded or replaced at its discretion.

The implementation of a mapping system, whether integrated with the CPE or a stand-alone system will require a data source.

6.4 MAINTENANCE & MONITORING

6.4.1 Maintenance

The PSSO would also need to consider what role it would play in supporting the system. If the choice would be to maintain the system with PSSO personnel, the following issues will require consideration:

- Hiring and training staff
- Maintain staffing to support 24 X 7 operation
- Maintain staffing levels that meet PSSO guidelines for restoring service
- Maintain inventory of spares
- Rotation of inventory
- Storage of spare inventory
- How spares are replaced
- How spares are maintained with current firmware and software
- Where spare equipment will be stored
- Who will have access to the equipment

It will be necessary to provide repair services for all system components and peripherals including:

- 9-1-1 Tandem Switches
- Selective Routers
- Trunking and signaling systems
- CPE
- Network Interface Equipment
- WAN /LAN Equipment
- Operating system software
- Application software
- Database systems and software
- UPS
- Electrical
- Grounding
- Servers and workstations

In considering the level of commitment necessary by the PSSO required to meet these needs, it must decide which method will best serve its short and long term goals. If the PSSO would choose not to take on this level of responsibility, contracted maintenance and monitoring are still an option.

6.4.2 Monitoring

The monitoring of the system and all components would require the state to establish a Service Response Center (SRC) or Network Operations Center (NOC).

Monitoring for the systems would include:

- 9-1-1 Tandem Switches
- Selective Routers
- Trunking and signaling systems
- CPE
- Network Interface Equipment
- WAN /LAN Equipment
- Operating system software
- Application software
- Database systems and software
- UPS
- Electrical
- Grounding
- Servers and workstations

In order to monitor the components in real time, a network solution utilizing Internet protocol (IP) and a suite of diagnostic tools from various vendors that would support the level of monitoring are necessary. These diagnostic and monitoring tools can be utilized to provide reports on the current status and health of the 9-1-1 systems. The implementation of this IP based monitoring

solution would require personnel who are trained in their use and who have a working knowledge of all other aspects of the 9-1-1 systems.

Documentation of all network, system, and equipment for each PSAP will need compiled creating a "PSAP profile". This profile will assist technicians and PSSO staff in ensuring that each PSAP is restored to its designated operational capacities and capabilities after filing a trouble or service request with the monitoring group.

The monitoring solution implemented would also need to operate as a single point of contact. This would mirror the process that the PSAPs are accustomed to using today when they need to place a trouble report. Polices on how to receive, document and prioritize trouble reports and outages will require development. This will ensure that all equipment failures, 9-1-1 outages and other trouble reports are received, prioritized and dispatched to repair technicians in a consistent manner. These polices will also outline response time criteria and the escalation procedures to be used in the event a situation exceeds the established criteria for response and resolution.

6.5 TRAINING

The training curriculum would need to be redeveloped to reflect system architecture and operations of the E9-1-1 systems being deployed. It is possible that the current plan used to train personnel for the existing wire line system could be adjusted to prevent a full rewrite of the training program.

During the revision of the training curriculum, consideration would need to be given to the 9-1-1 systems and their functions including:

- 9-1-1 CPE operation (Wireline and Wireless)
- 9-1-1 call handling procedures (Wireline and Wireless)
- TDD/TTY
- Instant Recall Recorder (IRR)
- 1st level trouble shooting
- Trouble reports
- Emergency Trouble Reporting
- Alternate routing
- Default routing
- Silent call handling procedures

6.5.1 9-1-1 User Training Considerations

- Design new user training manuals
- Design new PSAP Administrator manuals
- Design new training slides and / or power point presentations
- Train PSAP administrators
- Train PSAP telecommunicators
- Train PSSO staff on new equipment operations

Training and documentation will be necessary to assist all personnel responsible for implementing, operating and maintaining core system components. These would include the following:

6.5.2 System Training Considerations

- Design new training manuals
- Design new training slides and / or power point presentations
- Train PSSO staff on new equipment operations
- Train PSSO system administrators
- Train PSSO staff on statistical data collection and storage
- Train PSSO staff on Statistical Reporting and Analysis
- Train PSSO staff on building Username and Password entry for Administrators, Supervisors, and Telecommunicator system access
- Train PSSO staff on building Administrator, Supervisor, and Telecommunicator access to CPE feature sets
- Train PSSO staff on remote access of 9-1-1 system
- Train PSSO staff on database implementation, updates, and synchronization of ALI data
- Train PSSO staff on building and modifying ESN and telephone number s for routing purposes
- Train PSSO staff on system data backup and storage
- Train PSSO staff on SMART terminal use and access
- Train PSSO staff on Call detail reporting
- Train PSSO staff on use of Instant Recall Recorder software